This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

Ac T 93.39775 (7)

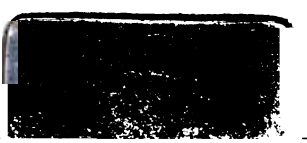
HARVARD COLLEGE
LIBRARY

FROM THE LIBRARY OF

MRS. ELLEN HAVEN ROSS

OF BOSTON

RECEIVED JUNE 28, 1938



3 2044 096 989 447

Mary Eliza Haven.

Mary Eliza Haven.

THE

SCHOOL LIBRARY.

PUBLISHED UNDER THE SANCTION

of the

Board of Education

OF THE STATE OF

MASSACHUSETTS.

JUVENILE SERIES.

BOSTON:

MARSH, CAPEN, LYON, & WEBB.

THE

SCHOOL LIBRARY.

PUBLISHED UNDER THE SANCTION OF THE BOARD OF EDUCATION OF THE STATE OF MASSACHUSETTS.

JUVENILE SERIES.

VOL. VII.

SCENES IN NATURE;

OR

CONVERSATIONS FOR CHILDREN,

ON

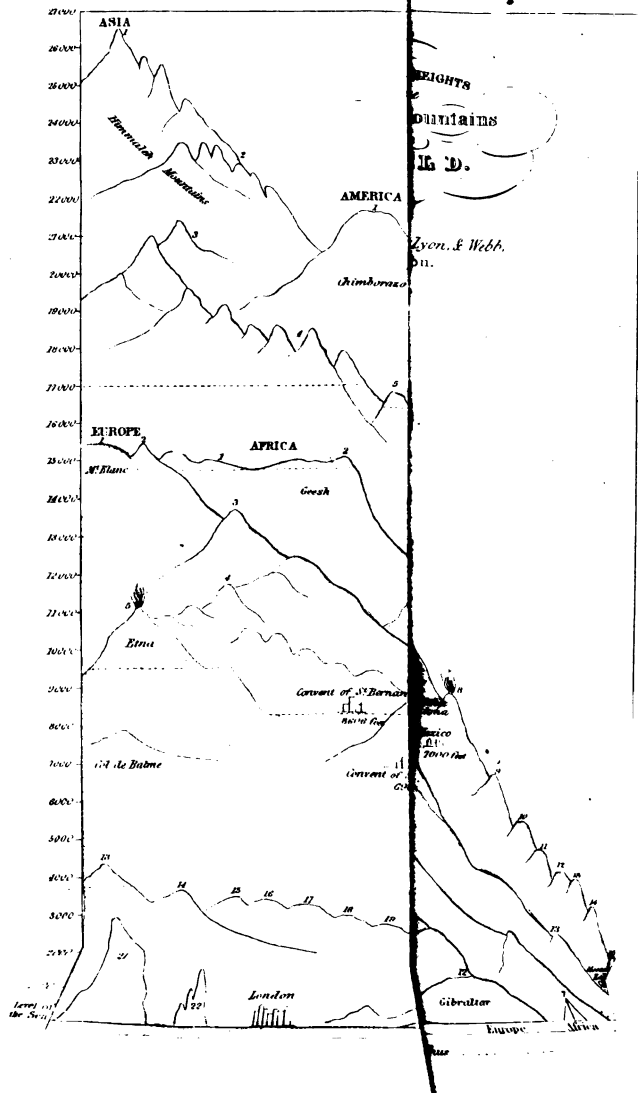
LAND AND WATER.

WITH ENGRAVINGS.

BOSTON:
MARSH, CAPEN, LYON, AND WEBB.
1840.

This Volume is sanctioned, by the Board of Education of the State of Massachusetts, as one of the Series, entitled, 'The School Library,' published by Marsh, Capen, Lyon, and Webb.

EDWARD EVERETT,
GEORGE HULL,
EDMUND DWIGHT,
GEORGE PUTNAM,
ROBERT RANTOUL, JR.,
THOMAS ROBBINS,
JARED SPARKS,
CHARLES HUDSON,
GEORGE N. BRIGGS,
WILLIAM G. BATES.


ASIA
Himmalaya Mountains
AMERICA
Chimborazo
EUROPE
Mt Blanc
AFRICA
Geesh
Etna
Convent of St Bernard
Mt de Balme
London
Gibraltar
Europe
Africa
Level of the Sea

Sarah Ann Hall

SCENES IN NATURE;

OR,

CONVERSATIONS FOR CHILDREN,

ON

LAND AND WATER.

BOSTON:
MARSH, CAPEN, LYON, AND WEBB.
1840.

Δ
Educ T 98.39.775 (7)
✓

HARVARD COLLEGE
JUN 28 1938

Mrs. Ellen H. Ross

Entered according to Act of Congress, in the year 1839, by
MARSH, CAPEN, LYON, AND WEBB,
in the Clerk's Office of the District Court of Massachusetts.

EDUCATION PRESS.

PREFACE.

THE following little work is based upon a small volume, composed by a lady, who has done, and is still doing, much to enlighten and instruct childhood and youth, and indeed many of a still maturer age ;—a lady, who, to her credit be it said, has made it the great end and aim of her being, to inculcate correct knowledge and sound principles in the minds of the young ;—a lady, who has strong claims upon our good-will and gratitude, for the charms with which she has invested numerous subjects, otherwise dry and uninteresting, and for the happy manner in which she has simplified, and brought down to the capacity of ordinary minds, many matters of science, that, without such aid, would have been far too abstruse for the majority of readers. This lady is Mrs. MARCET, who, many years since, became favorably known by her very excellent work, entitled, 'Conversations on Chemistry,' of which, it is scarcely too much to say, that it did more to excite an interest and

sustain a taste for chemical pursuits among the young, than almost all publications that had appeared for a long period previous. Subsequently, she fully sustained her well-earned reputation by several works, constructed on a similar plan, intended as familiar introductions to various departments of science, so attractive in style, and so accurate in facts, as to have been used as text-books in many schools and academies. Never wearying in doing good, she has more recently devoted her time and talents to the highly-praiseworthy, although heretofore too-much-neglected, purpose, of imparting knowledge to the *young* child. Among other volumes that she has produced, with this object in view, is the one, by her entitled, 'Conversations for Children, on Land and Water.' This, she informs us, "consists of desultory conversations, with a family of children from six to ten years of age, in which she has endeavored to mingle information with amusement, and to teach those of her young readers, who may be learning Geography, that there are other matters connected with land and water quite as interesting as the names and situation of the different parts of the earth."

Believing this would prove a valuable, as well as

interesting volume for the Juvenile Series of 'THE SCHOOL LIBRARY,' we have ventured to add to its pages in order to make it of a suitable size. So numerous and various are the additions, and so interwoven are they with the original text, that we have not deemed it advisable to place the name of Mrs. M. on the Title-page; and at the same time, as an act of justice, we would say to the reader, for the information herein contained, you are more largely indebted to the Author, than the Editor.

T. H. W.

Boston, January, 1840.

CONTENTS.

CONVERSATION FIRST.

Mountains.—Alps.—Granite Rocks.—Needles.—Effect of Rain on Mountains.—Appenines.—Rivers flowing through Valleys.—Springs coming from Caverns filled with Water in Mountains, ... Page 11

CONVERSATION SECOND.

Rivers composed of the Junction of a Number of Rivulets or other Rivers.—Avon.—Missouri.—Mississippi.—Nile.—Motion of Boats on Rivers.—Lakes.—Islands.—Ponds, 21

CONVERSATION THIRD.

Ponds fed by Springs.—Zirknitz Sea.—Bursting of Lakes in mountainous Districts.—Valley of Bagnes.—Plan in Relief, of the Alps, ... 34

CONVERSATION FOURTH.

How Rivers find their way to the Sea.—Lake Maggiore and its Islands.—Comparative Map of the Size of Mountains, ... 45

CONVERSATION FIFTH.

Chimborazo in South America.—Mount St. Bernard—Convent of Monks ; Dogs, &c.—Thinness of the Air at great Elevations.—Quito.—Account of Waterfalls, . . 53

CONVERSATION SIXTH.

Waterfalls, continued.—Falls of Montmorenci.—Chaudiere Falls.—Cataract of Niagara, ... 67

CONVERSATION SEVENTH.

Comparative Map of Rivers.—Large Scale of Nature in America.—Rivers Amazon and Ganges compared.—Di-

rection and Size of Rivers.—Rivers in Europe.—Boundaries of Countries marked out by the Direction of Rivulets.—Size of Rivers generally corresponding to their Length, flowing through Valleys into Basins, . . . 83

CONVERSATION EIGHTH.

Why Towns are usually built on Rivers.—Land and Water Carriage, Steam Boats.—Rowing Boats.—Rate of Wages.—Towns formerly built on Hills—Rome; Boston, or Tremount, ... 93

CONVERSATION NINTH.

A real Spring visited, and followed to its Junction with a River.—Intermittent Springs.—An Island in the River.—The Sea.—Islands in the Sea.—The Summits of submarine Mountains.—Sea Weeds and Fishes.—Battle between a Whale, a Shoal of Herrings, and a Flock of Sea Gulls, ... 105

CONVERSATION TENTH.

Earth carried down to the Sea by Rivers.—Rapidity of Currents.—Freshets.—Embankment of Rivers flowing from the Appenines.—Mountains upheld by Grass.—A Sod of Grass examined.—Earth supported by Roots of Trees.—Branches of Forest and of Fruit Trees.—Landslips, 116

CONVERSATION ELEVENTH.

Goldau.—Story of Marie buried alive.—Landslip at the White Mountains.—Avalanches of Snow.—Glaciers Avalanches.—Ascent of Mont Blanc, ... 126

CONVERSATION TWELFTH.

Deltas—In the Sea; in Lakes.—Delta in the Nile.—Overflowing of the Nile.—Delta of the Danube.—Of the Ganges.—Colors of Rivers.—Tendency of flowing Waters to reduce the Globe to a level, ... 138

CONVERSATION THIRTEENTH.

Why the Sea does not overflow.—Mediterranean.—Vapor rising from the Sea invisible.—Evaporation general to Liquids.—Drying Linen.—Lakes and Seas, . . 147

CONVERSATION FOURTEENTH.

Currents of Wind.—Account of a Hurricane, . . 156

CONVERSATION FIFTEENTH.

Cause of the Saltness of the Sea.—Salt Lakes and Springs.—The Dead Sea.—Evaporation of a Glass of Salt Water by Heat.—Buoyancy of Salt and Fresh Water, . . 168

CONVERSATION SIXTEENTH.

Rain-water pure.—Mists.—Fogs.—Exhalations.—Springs acquire Flavor, and are cleansed, by running under Ground. —Natural Filters. —Experiments on Filters of various Kinds. —Mineral Springs. —Ballston. —Saratoga. —Hot Springs, ... 179

CONVERSATION SEVENTEENTH.

Hot Springs of Iceland.—Volcanoes.—Ascent of Mount Vesuvius.—Description of its Lava, Cone, and Crater.—Lava heated internally swells out.—Expansion of Bodies by Heat.—Origin of Mountains, ... 194

CONVERSATION EIGHTEENTH.

Power of Steam.—Power of solid Bodies suddenly converted into Air.—Gunpowder.—Firing off a Cannon.—Explosion.—Cracking a Whip.—Different Degrees of Expansion of Bodies.—Bodies that ignite spontaneously.—Experiments on Iron and Sulphur with Water.—Water does not in all Cases extinguish Fire.—Example, the Burning of Potassium in Water, ... 209

CONVERSATION NINETEENTH.

Account of the Destruction of Herculaneum and Pompeii, and their subsequent Excavation.—Description of Pompeii. —Earthquake near Puzzuoli.—Monte Nuovo thrown up in 1538.—Raising of the Coast.—Temple of Serapis.—Account of the Eruption of Vesuvius in 1631; in 1839.—Mount Etna, ... 220

CONVERSATION TWENTIETH.

Submarine Eruptions.—New Islands in the Mediterranean.—

Isles near Iceland.—Mount Hecla.—Hot Springs.—Number of Volcanoes in an active State.—Origin of Mountains, ... 231

CONVERSATION TWENTY-FIRST.

On Earthquakes.—That of Lisbon in 1755 described.—Earthquakes in Chili.—Raising of the Coast.—Eruption of Tombaro, in the Island of Sumbawa.—Earthquake at Aleppo, ... 244

CONVERSATION TWENTY-SECOND.

Account of sandy Deserts.—Wells.—Caravans.—Camels.—Simoom.—Arabs.—Steppes.—Pampas, . . . 259

CONVERSATION TWENTY-THIRD.

On the Formation of natural Soil, on a barren Rock.—Of the nutritive part of Soil derived from dead Vegetables.—Of the Use of the Earth in Soil, to support Plants and retain Water, ... 269

CONVERSATION TWENTY-FOURTH.

The Sand of the Sea.—Coral Reefs.—Tripoli Earths.—Difference between Animals, Vegetables, and Minerals.—Account of Stones.—Adventures of a Stone, . . 280

TABLES.

Of the Heights of Mountains, ... 296
Of the Lengths of the principal Chains of Mountains, 298

GLOSSARY, ... 298

INDEX, ... 304

SCENES IN NATURE.

CONVERSATION FIRST.

MOUNTAINS. — ALPS. — GRANITE ROCKS. — NEEDLES. EFFECT OF RAIN ON MOUNTAINS. — APPENINES. — RIVERS FLOWING THROUGH VALLEYS. — SPRINGS COMING FROM CAVERNS FILLED WITH WATER IN MOUNTAINS.

MRS. B. had given the first lesson of geography to her two youngest children, and afterwards sent them to play in the garden with their elder brothers. They remained there so long that she went out to see what they were doing, and, to her surprise, found them all busy, making mountains.

The gardener had collected, in one corner of the melon-ground, a store of clay, sand, chalk, and road-dust, and with these materials the children were making free, and raising them into heaps, of various shapes, in imitation of mountains.

"Look, mamma," said Edward, who was beating a large lump of clay with his spade, "this is to be Mont Blanc, which is always covered with snow."

"And where do you intend to get the snow?" asked *his mother*.

"O! I wish it was winter," replied Edward, "for then I might have real snow; but I will tell you what I will do; I will crumble some of that white chalk over it, and that will look like snow."

"And what are you doing, William?" inquired his mother.

"I am building up another of the Alps with large stones, which I mean to be rocks of granite; for you told us those mountains had granite rocks underneath the snow; and I am fastening them together with clay, and afterwards I can cover it with chalk, like Edward, to imitate snow; but I shall let some of the sharpest pointed stones jut out beyond the snow, as you say the rocks do in the Alps."

"Very well thought of," replied his mother; "and when these projecting peaks are very pointed, they are called needles."

"But, mamma," said Sophy, "surely a piece of rock can never be so thin and sharp as a needle?"

"No, indeed, my dear; they are only compared to needles. The smallest of them are a great deal larger and higher than the church steeple; but they have no other resemblance to a needle than being pointed."

Little Caroline was very much amused at the idea of a pointed rock being like a needle, and said, "What a large thread would be wanted to thread such needles. I think it should be the cable of a great ship."

"There is no eye to those rocky needles,"

View of the Aquille de Dru, (one of the 'Needles,') in the valley of Chamouni, in the Alps,—a taper spire of granite which shoots up to the height of eleven thousand feet above the level of the sea.

said Edward, "so you need not think about the thread."

"Nor any giants big enough to work with them," observed Sophy.

Their mother told them that in French these peaks or needles were often called *teeth*, and in German *horns;* and she thought they looked more like teeth and horns than like needles.

Edward desired his mamma to observe how he made it rain upon his mountain. He stood upon a garden-chair, to raise himself above his mountain, and holding his little watering-pot as high as his arms could reach, he poured water through the spout, which was pierced with holes, and which made it fall on the mountain just like drops of rain.

All the children turned round to admire Edward's imitation of rain. Part of the water trickled down the sides of the mountain, and part sunk into it, as their mother had told them the rain did in real mountains.

"You have succeeded extremely well, Edward," said his mother, "only I must tell you that it very seldom rains on Mont Blanc, for it is so cold there that the rain is almost always frozen, in summer as well as in winter, and falls in snow."

"Is snow frozen rain?" asked Caroline.

"Yes, my dear; you know that when snow melts, it turns to water."

"Well, then," said Edward, "as I cannot make it snow upon my mountain, it shall not be Mont Blanc, but one of the smaller mountains of

the Alps, where it is not so very, very cold, and where it rains in summer and snows in winter; and it is summer now, you know."

Caroline begged her brother to lend her his watering-pot, that she might make it rain on her mountain; and asked her mamma what it should be called.

"I think," said Mrs. B., "it looks like one of the Appenines in Italy."

Caroline had heaped up a mountain of sand and road-dust, mixed with some fine gravel, because she found those materials more easy to move; besides, they did not adhere to her fingers, and soil them, as she had observed the clay did which Edward used, nor were they so heavy as the large stones which John had used to construct his mountain.

Edward lent her the watering-pot; but no sooner did she pour water upon her mountain than its surface or outside began to crumble away, and came down with the water, in thick, muddy streams, quite unlike the clear rills which flowed down Edward's mountain.

Caroline was sadly disappointed; but her mother told her it only made her mountain more like one of the Appenines, the surface of which crumbled down mixed with water, whenever it rained hard.

"Indeed!" exclaimed Caroline, somewhat consoled by this resemblance; "but then have not the Appenines all crumbled to pieces and washed *down to* the bottom?"

"No; they are too large to be destroyed by the rain, though in the course of years they are certainly diminished by it."

"And are the rivulets which run down the Appenines thick and muddy, like those of my mountain, mamma?"

"Yes, just the same."

"Then I suppose they make the rivers muddy which they fall into?" said William.

"Yes; especially after a violent rain: for then the streams rush down in torrents, bringing with them a prodigious quantity of sand and earth. I have seen the river Arno, at Florence, look almost as dirty as the mud in the streets after a heavy rain, whilst in fine weather it is clear, for then the rivulets, being less full of water, and therefore flowing more gently, bring down less earth, and most of it subsides to the bottom, which it had not time to do when borne along with such impetuosity as it is during violent rains."

"And will not William's and Sophy's mountains crumble away at all, mamma?" asked Caroline, who could not help still feeling a little jealous of her brother's and sister's mountains.

"Yes, they will; but not so much as yours, as they are made of harder materials, which do not crumble away so easily. As you are all making mountains," continued she, "it is a pity you did not range them in two lines so as to form a valley, and then you might have had a river running through the valley."

"A river of real water?" asked little Cary; "and where would it come from?"

"Don't you see," said Edward, "that all the little streams, which run down the sides of the mountains, after it has rained—I mean rained from our watering-pots—will come into the valley at the bottom, and being all joined together, there will be water enough to make a river?"

"Large enough for boats to float on?" inquired Caroline.

"Not large enough for real boats, certainly," said William; "but perhaps it would float a paper boat."

"O! how funny that would be!" cried Caroline; "do let us place our mountains in two rows, so as to make a valley."

With the assistance of the gardener, the mountains were easily brought closer together, and half a dozen others thrown up, so as to make two ridges, with a narrow valley between. Mrs. B. desired the gardener to take care to make the valley higher at one end than at the other; for if it were level, the river would not flow. This being done, the gardener made a furrow, or sort of gutter, through the valley, to serve as a bed in which the river would flow, else the water would have spread all over the valley.

"But we must also prevent the water from sinking into the ground," said Mrs. B.; "how can we manage that?"

"O! plaster the bed of the river over with clay, *for you know* that water will not sink through

clay." As soon as this was done, the gardener brought the water-engine used for watering the garden, and poured more rain over the mountains than a dozen watering-pots could have done; some of it sank into the mountains, but the greater part ran down their sides.

"I wish none of the water sank into the mountains," said Edward, "for then we should have more in the rivulets to fill the river in the valley."

"Very little sinks into your mountain," said his mother, "because it is made of clay; but that is not the case with Sophy's. Look! almost all the rain sinks into it. What is your mountain made of, Sophy?"

"All sorts of things, mamma; whatever I could get, and a great deal of sand to fill up all the holes."

"That is the reason you have so few rivulets, for water very easily sinks through sand; so the rain goes into the ground, instead of running down outside."

"O, but look!" cried Sophy, with joy; "here is a little rivulet running out of a hole on the side of my mountain. Where can it come from?"

"It must come from the water that was poured over your mountain, and which sank into it," said Edward.

"But then," said Sophy, "why does it not sink to the bottom, instead of running out at the side? Look! the hole at which it runs out is not much more than half way down the mountain."

Edward declared he could not tell, and the children all looked to their mother for an explanation.

Mrs. B. said, that she thought the water sank into the mountain till it met with something which it could not get through. What could that be ?

"Some hard stones, I dare say," said Sophy; "I remember that I put some stones in my mountain, to imitate pieces of rock, and water cannot get through stones."

"No," replied her mother; "but it may get between them; you know how quickly water runs through a heap of pebbles or small stones."

"I guess what it is," cried Edward, with a look of exultation. "I dare say there is some clay inside your mountain, and it is that which stops the water. Do let us look at the inside of Sophy's mountain !"

"O,no!" cried Sophy, with alarm, and standing with her arms spread out in front of her mountain, in order to protect it. "You would quite spoil my mountain, and the little rivulet too."

After some further discussion, however, she suffered herself to be persuaded; her curiosity being raised as much as that of her brothers and sisters. So the upper part of the mountain was carefully taken off, and what should they see inside but a large lump of clay, hollow in the middle, and nearly full of water.

"Look !" said Edward, with an air of triumph, "there is the clay I thought of; it stops the water, *and makes* a little pond."

"True," said his mother; "the water, being unable to sink through this cavity, rested in it, and as more rain fell, it became fuller and fuller, till at last it found an opening on one side of the cavity, and down that it ran, and went on, till at length it made its way out, on the side of the mountain. Now this happens continually in real mountains; and water, that runs out of the side of a hill or a mountain in this manner, is called *a spring*."

"How glad I am," cried Sophy, "that I put that great lump of clay in the middle of my mountain. I little thought what it would do, and only put it in to fill up, and I had great trouble to move it, besides its dirtying my hands and soiling my frock, too. But if I had not put it there, the water would have sunk to the bottom of the mountain instead of running out on the side."

"And why has not my mountain a spring," said Edward, "for it is made all of clay?"

"That is the very reason it has not," replied his mother. "Being made entirely of clay, the water will not sink into it, but trickles down the sides in little rills."

"O, yes!" said Edward; "now I understand it. The water must sink to some depth in the mountain, and then be stopped, and there it makes an inside pond; and then, if it finds a hole any where, to get out, it runs out till it finds its way to the open air, on the side of the mountain."

"The rain dribbling through the earth," said his mother, "often meets with natural caverns where it may lodge, for there are a great many

holes and cavities under ground fit to receive the water and to retain it, the bottom being either of clay or stone, through which it cannot penetrate. These inside ponds, as you call them, are more properly distinguished by the name of reservoirs ; they are a sort of natural cistern in which the water is kept to supply the spring. Then you must observe, that the opening, through which the water finds a passage from these reservoirs to the spring, must not be, as you say, any where; for, were it higher than the surface of the water in the reservoir it could not run out."

"Then," said Edward, "the hole, through which the spring gushes out into the open air, must be lower than the reservoir, for water will not run upwards."

"Certainly not," replied his mother ; "in no part of its course can a spring rise higher than its reservoir."

CONVERSATION SECOND.

RIVERS COMPOSED OF THE JUNCTION OF A NUMBER OF RIVULETS, OR OTHER RIVERS.—AVON.—MISSOURI.—MISSISSIPPI.—NILE.—MOTION OF BOATS ON RIVERS.—LAKES.—ISLANDS.—PONDS.

At their next meeting, Mrs. B. told her children that mountains were full of such springs as she had described at their last conversation, and she asked Edward what these springs were called when they flowed above ground.

"They are called brooks, or rivulets," replied he, "and when several of them join together they make a little river."

"Then," said Sophy, "rivers are not made of the water which runs down the outside of the mountains only, but of that which runs down the inside also, and spouts out of the ground wherever it can find an opening."

"Yes," said her mother; "and remember that the rivulets which gush out from the inside of a hill or mountain are called springs."

"But," said William, "rivers must receive much more water from the outside rivulets, because they run down so fast, and immediately after it has rained; whilst the rain that sinks into the ground must take a long time to make its way to

the reservoir, and then another long time to get from the reservoir to the spring ; besides, a great deal of it must be lost in the ground."

"A great deal remains in the ground, it is true," said his mother, "but every thing is so wisely arranged in Nature, that nothing is lost. Cannot you guess of what use the water, that remains in the ground, is ?"

"I can," said Sophy; "it is sucked up by the roots of plants, and makes them grow, as you showed us in our little garden, mamma."

"You are right; yet notwithstanding this diminution of water, rivers are in general better supplied by springs, than by the streams that flow down the mountains, outside. These, it is true, after violent rains, gush down in torrents, and suddenly fill the rivers in the neighborhood, so as often to make them overflow. I have known bridges carried away, and roads rendered impassable, by the size and impetuosity of these torrents. But no sooner is the rain over, than they diminish, and shortly after cease entirely ; so that the bed of a torrent, in fine weather is filled only with the stones which it had rolled down whilst in activity. The springs, on the contrary, continue to flow regularly, be the weather wet or dry ; because there is a store of water collected in the reservoir, which supplies the spring in fine weather as well as when it rains."

"It is like a cistern of water," said Caroline; "and the cock is the spring where the water

spouts, out. But our cistern is dry, sometimes, mamma !"

"And it happens so sometimes with a reservoir," replied Mrs. B., "if the dry weather continues very long; for the spring that runs from it will in the course of time empty it, unless it is replenished by rain descending from the surface of the ground. This, however, seldom happens, fresh rains generally falling before the reservoir is exhausted."

While they were thus talking, the attention of the children was suddenly caught by a little stream which began to trickle down the valley between their mountains. "Look ! look ! mamma," exclaimed they; "the little river is beginning to flow." Though scarcely more than two inches wide, the sight of it delighted them; they clapped their hands, and jumped for joy. As soon as they became more quiet, their mother told them to observe, that the river was very small at the beginning, in the upper part of the valley, but that, as it flowed on, more and more rivulets running into it, it grew larger and larger; and the same thing, she said, happened with a real river.

"And what becomes of a real river at last, mamma ?"

"At last it runs into the sea."

"So then," said Caroline, "little springs and rivulets are the beginning of a river, and the sea is the end of it. Suppose now we were to make believe that the pond down in the meadow was

the sea, then if our little river runs on till it reaches the pond it will end there ?"

"O, yes!" said Edward; "and I think we can manage to make the river run into it, because the pond is in lower ground." They then set to work to continue the furrow or gutter, which served as a bed for the river, towards the pond, in order that it should take its course that way.

"The pond is but a paltry little sea," said Caroline, "but it will be big enough to swallow up our tiny river." She then reminded her mother of the boat that was to float upon the river; and to her great delight her mother made a paper boat sufficiently small to float upon the river, and it was carried on by the current of the water.

"If it goes on so," said Caroline, "it will get to the sea at last; and yet boats in a river don't all go to the sea. Some go up the river, and some down it."

"True," said her mother; "but they are not left to themselves, else they must follow the current of the river; they are guided by men, who row them, or spread sails, and the boat then moves in the direction in which it is rowed or made to sail.

"But if a boat be left to itself, and not fastened by an anchor, it would float down the river until it reached the sea, unless it were stopped in its course by running against the banks or sides of the river, which, as rivers wind so much, is almost sure to happen, sooner or later."

"*Just as* our boat has done now," said Wil-

liam; "there was a little turn in the river, and having no one on board to guide it, it ran right against the projecting bank, and is fastened in the mud."

"Yes; the poor boat is stranded, and will never reach the sea," said Edward.

Caroline deplored the loss of the pretty little boat, which soon became a complete wreck, the water wetting the paper and quite destroying it.

"I must tell you," said Mrs. B., "that though the water in every river pours into the sea, every river does not reach the sea."

"How can that be?" asked Sophy, with surprise; "are not the river, and the water which flows in it, the same thing? so how can the water pour into the sea unless the river reaches it?"

"It appears rather puzzling, I own," said her mother; "but you will easily understand it. Run into the library, William," added she, "and bring us the small atlas."

When William returned, Mrs. B. showed her children the river Avon in the map of England.

"O! I know the Avon," said William, "it is where the great poet Shakspeare lived, and he was called the Swan of the Avon."

"A poet, a swan, and swim on the Avon!" exclaimed little Cary, with astonishment.

"No, no," said William, laughing; "he was a man who lived in a town, which was built on the side of the Avon, but perhaps he might swim in the river sometimes to amuse himself."

"*Well,*" *continued* their mother, "if you

follow the course of this river, you will see that it runs into a larger river, called the Severn, and both united make but one stream. Now, as this river cannot have two names, you must choose one of them, and the Severn being the larger, that is the name preserved. So you see, that though the waters of the Avon go into the sea, the river Avon itself finishes when it joins the Severn."

"Now I understand it," said Caroline; "and look, mamma," continued she, pointing to the map, "here are two other rivers which join and run on together."

"That," said her mother, "is the Medway, which runs into the Thames, and there loses its name; the Thames, being the larger river, gives its name to the united stream, and flows into the sea. There is indeed no large river which, in its course, does not receive the waters of several other rivers before it reaches the sea.

"Some of the largest rivers known, do not empty their waters directly into the sea. There is the noble Missouri, which, rising in the Rocky Mountains, after running the distance of more than three thousand miles, receiving in its course, as you may see by tracing it on the map of the United States, numerous tributary streams, empties its waters into the great Mississippi; and the united waters, still pursuing their onward course, and constantly enlarging by the accessions from other rivers, finally, having proceeded upwards of a thousand miles further, empty into the sea about *one hundred* miles below New Orleans. There

is also the Ohio River, that itself receives a vast number of streams, in comparison with almost any one of which, the Thames and the Severn dwindle down to mere rivulets, cannot reach the sea, without uniting itself with the Mississippi."

"What a big stream the Mississippi must be!" said Caroline.

"What a mighty and proud one!" added William.

"It is indeed very large," replied their mother, "having no superior in the world, viewing it, as we should, from the rise of the Missouri to the outlet of the Mississippi, as one continuous stream. It is also a very powerful one; and were inanimate matter possessed, like man, of various emotions and passions, it might well be proud of the number and size of the streams that are continually bearing along and depositing with it the great volume of water that they accumulate; and truly might it exclaim, 'I am monarch of all I survey.'

"I might," continued Mrs. B., "point out many other instances of streams not emptying directly into the sea, for our country abounds with them; but the examples already given are sufficient for our present purpose; and it will be a useful exercise for you, children, to take the atlas and trace them out, yourselves, as you will thus be more likely to remember their situation, origin, course, and termination, and may be induced to make yourselves acquainted with the places through which *they* pass, the people who inhabit

the places, if inhabited, and a great many other interesting matters.

"Not only do numerous rivers receive the waters of tributary streams, but sometimes, with very large rivers, the reverse is the case. Thus the Nile, to discover the sources of which so many years have been spent in fruitless research, at a great cost of money, and large sacrifice of life, pursues its course for upwards of one thousand miles, without having a single river empty into it."

"Then I should think, mamma," said Sophy, "that the Nile would have much greater reason for being proud, than the Mississippi, depending as it does, less upon contributions or exactions from others to support its dignity."

"Yet," replied her mother, "free and independent as it seems, for many and many miles, it would soon cease to be, were it not for the aid it receives during the first portion of its course. Thus Nature, by the dependence she has established among inanimate creation, teaches a useful lesson to mankind, showing us how mutually dependent we are upon one another; the rich man rolling in his wealth could not, unaided, long survive, any more than the poor man, surrounded by indigence; but, by an exchange of the money of the one for the labor of the other, benefits result advantageous to both."

"But, mamma," said Edward, "suppose a river, in its way to the sea, were stopped by some *high bank*, or something else, which it could

neither get over nor get round, what would become of it then ?"

"Indeed," observed Sophy, "that is very likely to happen somewhere or other; for you know a river runs a long way before it reaches the sea; sometimes a great many hundred miles !"

"If the river flows in a plain," said their mother, "there is scarcely any difficulty it cannot get over, or rather, I should say, get round, where there is room for it to wind about; but in a close valley, with mountains on either side, it is sometimes so completely shut in that it cannot proceed in any direction. Let us see, with your little river, what would happen in that case;" and she took a spade and heaped up the ground in the narrowest part of the valley, so that the water was stopped in its course.

"I wonder what it will do now," said Edward. The children all watched the water with deep attention, and they saw that, as it could not proceed onwards, it remained where it was; and as the river kept constantly flowing to this spot, the water rose up higher and higher, and spread out wider and wider, covering the banks on either side, till at last it made a long, narrow, little pond.

"O! what a nice little pond !" cried Caroline.

"If you compare it with the size of your mountains," replied her mother, "you must not call it a little pond, but a large lake; and this is the way real lakes are usually formed in real valleys and mountains."

"I remember the lakes, mamma," said William, "to which you took me last summer. They were all in valleys between mountains. But what will happen if the lake goes on always increasing?"

"The water will continue rising till it finds some way out, and there it will make its escape and afterwards flow on, as it did before it was stopped. Look here," said she, "in a few minutes the water will have risen to this spot, where the embankment is lower, and there I dare say it will run out."

The children watched the rising of the water with eager curiosity, and when at length it rose above the level of the lowest part of the embankment, it flowed out. Then they all gave a great shout, as if to congratulate the river on regaining its freedom.

"It has made its escape at last," said Edward, "but will it all run out, and the pretty little lake be emptied?"

"No," replied his mother, "only so much of the water as is above the level of the bank can flow out; the rest must remain, as water cannot run upwards, you know."

"And yet you see, mamma," said Sophy, still apprehensive that the pretty little lake would be destroyed, "you see that it does not stop; it goes on running out."

"True; that is because the river goes on running in at the other end of the lake; and so long as the water runs in at one end, it may run out *at the other*, without emptying the lake."

"But suppose any thing happened to prevent the river from flowing in at the other end of the lake?"

"Then it would cease to flow out at this end, but all the water below the level of the embankment would still remain in the lake; or, if the outlet of the lake were at the bottom, all of the water would escape and the lake be dried up."

"Well, now the river flows on without interruption," said William. But this did not last long; it soon met with another obstacle; a great stone or piece of rock stood in the midst of the valley, and filled it so as to interrupt the course of the water. The children, impatient to see their little river reach the sea, begged the gardener to cease pumping a minute, in order to remove the stone, as it was much too large and heavy for them to lift; but their mother advised them to let it remain, and see what course the river would take.

The river, being pent up by the piece of rock, remained stationary, as before, and began to form another lake; then, after it had risen and spread some distance, it found its way round the piece of rock, which remained in the midst of the water like an island. This delighted the children; but they declared they would not have a desert island of barren rock; so they each ran to gather a flower or the twig of a tree to embellish their island. But the difficulty was to fasten them to the stone. They had once more recourse to the gardener, who plastered over the stone with a

thick coating of clay, to which every thing they gathered easily adhered, and they soon asked their mother to admire the beautiful wood which grew, or at least appeared to grow, on their island. "Look! mamma," said they; "it is in full blossom;" for they had so contrived to intermix the flowers with the green twigs that it really bore some resemblance to miniature trees in blossom.

"O! but," said Edward, "we must have some living animals to inhabit our island; now for a hunt! Let us each seek for some small enough to be in proportion to the size of the wood and the island." Upon this, they all scampered away. Sophy soon returned with a few ants, wrapped in her pinafore, for fear they should bite her fingers. Caroline picked up a couple of snails. Edward was so lucky as to catch a very small frog; and William had seized upon a tiny lizard, being anxious to have a quadruped in the island. "I could have caught plenty of butterflies," said he, "but then I thought they would fly away from the island."

These various creatures were all placed in the island. The ants seemed to be very uneasy in their new abode, and were seen running about under the trees in search of a secret place to hide the eggs they carried in their mouths. The snail hid itself among the branches. The frog was no sooner let loose, than it leaped over the lake, and concealed itself under the grass, and the lizard ran *off so swiftly* that the children could not discover

which way it went. All this was fine sport to them, and they stayed in this little world of their own creation till the dinner-bell summoned them to the house; and fortunately, just before it rang, they had the pleasure of seeing the small river, which for some time had been flowing along the meadow, fall into the pond, their make-believe sea; and the gardener, who had been all this time pumping to supply the river with water, was not sorry to rest from his labor.

CONVERSATION THIRD.

PONDS FED BY SPRINGS.—ZIRKNITZ SEA.—BURSTING OF LAKES IN MOUNTAINOUS DISTRICTS.—VALLEY OF BAGNES.—PLAN IN RELIEF OF THE ALPS.

WHILST the family were at dinner, the children's conversation naturally turned upon their river, lake, and island. Their father was much amused to hear what they had been doing, and encouraged them to continue on, saying he would go in the afternoon to see their work. This pleased them extremely.

Sophy inquired how ponds were filled; for there was no river running into the pond in the meadow, and yet there was a little rivulet running out of it when the pond was very full.

"A pond," replied her mother, "is often supplied with water by a spring which rises from the bottom, or opens upon the side, beneath the surface, and between it and the bottom. When a spring happens to find its way out of the ground, in a hollow place or cavity, the ground rising all round prevents the spring from running off in the form of a rivulet; it therefore accumulates in the same manner as a lake does, the pond growing deeper and deeper, as the spring fills *it with water*. A pond is often an artificial piece

of water; that is to say, the cavity which contains the water is dug in the ground, and is filled by a little rivulet running into it, or by a spring rising from the bottom."

"But if a spring flows into a pond," said Sophy, "it is much the same as if a river flowed into it; some water must flow out of it, or else the pond would overflow."

"It is to prevent this," said her mother, "that a small cut or opening is made at the edge of the artificial pond, for a little rivulet to run out."

"Yes," said Edward, "it is something like a gutter, and through this the water runs into a ditch; but all ponds have not such outlets. There are many ponds that never fill to the brim, and therefore do not require any."

"And yet," continued Edward, "if water is always pouring in from the spring, and never pouring out, the pond must overflow in time, however small the spring may be.

"There are many springs which are not themselves sufficiently supplied with water under ground to flow constantly; they then flow only after rainy weather."

"That is because the inside pond in the hill," said William, "is well supplied with water in rainy weather; then a little time must be allowed for it to get down to this inside pond, and after that to make its way out of the ground at the spring."

"I have read," observed Mrs. B., "of a very extraordinary *lake*, situated in Carniola, Austria,

and known by the name of the Zirknitz or Czirknitz Sea, the phenomena connected with which beautifully illustrate the consequences of furnishing a lake with, or depriving it of, a due supply of water. This lake, during the summer season is entirely dried up, and the ground thus exposed furnishes crops of grass, or such grain as may be sown by the neighboring inhabitants, to whom it is available for pasturage and other farming purposes until September, at which time the water again appears, and the lake is soon restored to its usual size. So that at one season of the year this spot presents to view a broad sheet of water, while at another it exhibits fields loaded with grain, and pastures teeming with herbage."

"How very queer!" exclaimed Cary.

"It certainly appears quite strange," continued her mother, "until the cause is ascertained. In former days, when ignorance more generally overshadowed the people, and superstition exercised a powerful sway upon the minds and thoughts of men, this disappearance and reappearance of the water of the lake would have been looked upon as the work of magic. But from the more extensive diffusion of knowledge, and proper exercise of reason, few will be found, at the present day, who would be satisfied with such an explanation, or who would not smile at the ridiculous notion that the operations of Nature can be controlled by an imaginary magical influence."

"But, mamma," inquired Edward, "does any *one know the* cause of these singular changes?"

"Yes," replied his mother, "an explanation has been offered, and so very simple is it, that I dare say William, who has told us so correctly why certain springs only flow after rainy weather, will be able easily to explain these changes, upon hearing a description, which I will now give, of the above-mentioned lake, and the adjacent country. The country is hilly, and the lake is enclosed by rising grounds, lofty mountains, and terrific precipices. In its ordinary state, the water has apparently no place through which it can enter or escape. The lake does, however, by subterraneous channels, have communication with two under-ground lakes, one of which is situated above, and the other below, its level. It empties itself into the second through the outlets in the bottom, and receives, in the winter, from the first, a supply equal in amount to what it parts with, and, of course, during that season remains full. A considerable river flows from the lowest lake. In the summer—"

"Pray stop, mother," cried William, with great glee, "I understand it all. The upper of the two subterranean lakes must depend upon the rains for a supply of water, and when these are the most frequent, it is enabled to furnish the middle lake with a quantity of water equal to that which flows from the middle one, into the lower subterranean one, and, of course, the former will remain full. This, it seems, happens in the fall, winter, and spring, when rain is most abundant. But *when the rains* are less frequent, the quantity

of water furnished to the middle lake must be diminished, and at last, so little rain falling, it must cease altogether, and the middle lake, still being drawn upon by the lower one as usual, must finally be emptied and become dry. This, we find, takes place in midsummer, when the heat is the greatest, and the amount of rain is the least. Am I right, mother ?"

"This is the opinion generally entertained," replied Mrs. B., "and will certainly very satisfactorily account for the alternate disappearance and reappearance of water under the circumstances here presumed to exist."

"But," said their father, "there is still another way, by which a pond is always losing water."

"Do you mean by people fetching it away in pails for washing and cooking ?" said Caroline.

"No," replied her mother, smiling; "that can happen only in the neighborhood of towns; but every pond is constantly losing by———" She was stopped by their papa putting his finger on his lips; and she added, "O! I forgot; we have not come to that,yet, so you must wait with patience some little while longer, before I can explain to you what this other mode of losing water is."*

After dinner, the children returned to their mountains, to see that every thing was in order to show their father. "But let us do something new," said William, "to surprise papa and mamma. Suppose that we were to stop up the rivulet

* See Conversation Thirteenth.

so well that it should not be able to get out at all, I wonder what would happen then."

"It will make a very deep lake, but it would get out at last, when it was full to the brim."

They set hard to work with their spades, and made a high mound or ridge of clay to join a very narrow pass between two of the opposite mountains, so that the rivulet which had flowed between them was quite shut up. The children's faces were flushed by the eagerness with which they worked, in order to complete the mound before papa and mamma should arrive. It was finished just in time. "Look," said William to them, "we are stopping up this rivulet; putting it into prison; and see what high prison walls we have made; it will never be able to get out." Papa admired their contrivance, and promised to stay to see what would take place. The children watched the rising of the water within the mound with breathless impatience, every now and then peeping over the mound to observe how fast the water increased.

"Look! mamma," said Sophy, "how deep our lake is getting; it will be quite large by the time it is full." But that time never came! for on a sudden the weight of the water made the mound give way, and the whole of the water in the lake burst out at once, covering the children with mud and water. They ran back startled; but papa only laughed, and said, "It is well it was but a Lilliputian or small lake; for when such accidents happen *with a real lake*, there are much more *serious consequences* than a mere splashing."

Mamma took the children into the house to change their clothes; and she afterwards showed them a plan in relief, or small model, of the Alps, in many parts of which there are very narrow passes between two mountains. The children, who had never seen a model of the kind, did not at first well understand it.

Caroline asked if it was bought at the toy-shop, it looked so much like a toy to be played with; and Sophy declared that the mountains they had been making were enormous in comparison with these. Mrs. B. told them the model was intended more for instruction than amusement; "but you know," added she, "that a great deal of amusement is often to be derived from instruction."

"O, yes!" said Caroline; "I am sure these tiny Alps are very funny. Here is Mont Blanc and all the snowy mountains painted white, and the woods painted green on the lower mountains; and I declare," added she, with astonishment, "here are little towns and villages in the valleys."

"I should not have thought," said Edward, "that a house would have been bigger than a pin's head, in comparison with such mountains; and these houses are much larger."

"You are quite right," replied Mrs. B.; "they are very much out of proportion to the mountains; but were they of the proper size, they would be nearly invisible, and consequently of no use."

"O, yes!" said Sophy; "it is much better to *have them* too large than not to be able to see *them.*"

"The mountains themselves," resumed Mrs. B., "are, I believe, in just proportion." She then pointed out one of the narrow passes in the Valley of Bagnes, above the town of Martigny, in the Valais, (Switzerland,) and told them that the River Drance passed through it, and descended into the plains below; that one season the course of the river had been stopped by huge pieces of ice which had fallen from the neighboring mountains, and which, together with the snow that had fallen during the winter, had frozen so as to form a solid mass of ice, a sort of wall or barrier, behind which the imprisoned waters accumulated, and formed a lake like that the children had been making.

"And were not the people of Martigny sadly frightened, mamma, lest the wall of ice should give way, and the lake burst through, and drown them all?"

"Indeed they were," replied her mother; "and the more so because their town had many years before been overwhelmed by a similar accident; and they knew that the more the water increased in the lake, the more it would press against the mound of ice, which would at length give way."

"I'll tell you what I would have done," said William; "I would have bored a hole through the wall of ice near the bottom, so that the water might pour through it, and come away gently, and the lake might thus be emptied by degrees, without *doing any mischief.*"

"That is exactly what they did," replied Mrs. B., "but it is not an easy matter to bore a hole through such a mass of ice, and only a small portion of the water could thus be drawn off, so that when the warm weather came, the mass of ice began to melt and detach itself from the mountains, and at length it gave way with a frightful crash and came rolling down the mountain, together with the whole body of water it had imprisoned, which burst forth with such violence that it carried away rocks, bridges, houses, trees, and, in a word, whatever it met with in its course. At length it fell into the Lake of Geneva, which it reached in six hours and a half, the distance being about fifty miles, having done a great deal of mischief, and, what is worse, having drowned a great many people. The marks of the height to which the water reached are still to be seen on the houses, though this accident took place so long ago as the year 1818."

"I wonder any body likes to live at Martigny," said Caroline, "for the same thing may happen again."

"No," replied Mrs. B., "a very ingenious man has invented a means of preventing such an accident from happening again. As there is an abundance of rivulets in those mountains, he contrived to make a great number of them flow towards the accumulated ice, by hollowing out shallow beds for them in that direction."

"That must have been in summer, mamma," *said Sophy*; "for in winter the rivulets would *all have been* frozen themselves."

"Certainly; and during the summer the water in these rivulets, which, as I told you, were very shallow, being exposed to the sun, becomes warm. I do not mean to say hot, but warmer than the water of rivulets commonly is. Each of these little streams makes its way through the ice by melting it; and the ice is thus cut through, as if with a saw; and in the course of time it is cut to pieces and falls down; so that there is no longer any danger of its being able to stop the course of the river."

"How glad that man must have been to have done so much good, and how grateful the people who live at Martigny must have been. Pray what is his name?"

"Mr. Vinet. It is indeed difficult to say whether he who conferred the benefit or they who received it must have been the most happy."

"But they must all have helped him work to make the new beds for these rivulets?"

"The inhabitants of Martigny are generally so poor, that it is as much as they can do to maintain themselves by their labor, so that they could not afford to work without pay, even though it was for their own benefit. But the frightful accident that had occurred excited so much interest and compassion, even in distant countries, that a subscription was easily raised, and a sum of money was collected sufficient to pay all the expense, not only of making the rivulets, but of keeping them in repair, so that Martigny may now be considered *as perfectly* safe to live in."

William and Edward expressed a great desire to be old enough to travel in these mountains; but Sophy and Caroline felt their curiosity in some measure diminished, from the fear of meeting with such a catastrophe as their mother had described.

William asked whether the mountains were too steep for boys to climb?

Mrs. B. replied, that they varied extremely, from the gentlest rise to the perpendicular rock; but that most mountains could be climbed by winding paths, if they were too steep to go straight up.

CONVERSATION FOURTH.

HOW RIVERS FIND THEIR WAY TO THE SEA.—LAKE MAGGIORE AND ITS ISLANDS.—COMPARATIVE MAP OF THE SIZE OF MOUNTAINS.

THE children the next day continued their examination of the model of the Alps, and were busy, tracing the course of the rivers which flowed through the valleys.

"What a number of rivers begin in the Alps," observed Sophy.

"No wonder," replied William; "such great mountains must be full of rivulets inside and outside, and so give rise to a vast number of rivers."

"It is true," said his mother, "that the more mountainous a country is, and the higher the mountains, the greater is the number of rivers that take their rise in it. Indeed, it is only high mountains, covered with perpetual snow, that give rise to very large rivers."

"And yet, mamma," said Edward, "if the snow is perpetual, it can never melt; and unless it turns into water, how can it make rivers?"

"I beg your pardon," answered his mother; "Mont Blanc is covered with perpetual snow; because so great a quantity of snow falls on it during the winter, that the sun in summer cannot melt *the whole of* it. It dissolves, however, in

abundance, during about three months of the year; but towards the middle of August, when the nights become long and the days short, the sun has no longer power to melt the snow in those elevated regions, and during the winter a fresh store of snow accumulates, which melts the following summer, without the mountain ever being uncovered."

Mrs. B. then pointed out to her children the Rhone, which takes its rise in the Alps, but being stopped in its course, forms the Lake of Geneva; and the water, after rising to a considerable height, so as to form a deep lake, finds its way out through the town of Geneva, and flows again in the form of a river.

"I think," said Sophy, "it is very likely that the people of Geneva may have made an opening for it; for if the lake had continued rising, the town might have been drowned."

"No," replied her mother; "the waters of the lake had found this opening long before the town of Geneva was built; and it is probably owing to the advantage of being at the same time on the margin of a lake, and of a river, that they were induced to build a town in that spot. But let us see what becomes of the Rhone, when it runs out of the lake."

Sophy observed that it could not run into the sea, for there was no sea in the model.

Her mother said that the Alps, being nearly in the centre of the continent of Europe, were very *distant from any* sea; but she showed them the

Rhone on the map of Europe, and traced its course till it fell into the Mediterranean Sea.

"Look," said William, pointing to the map, "how all these rivers find their way to the sea; they wind about, it is true, but they are sure to reach it, at last; one would almost fancy they knew their way."

"He who created them," replied his mother, "directs their course, by the laws of Nature, (that is to say, the laws which Almighty God has established to govern Nature,) and water always flows downwards.

"Now, can you tell me what is the reason that rivers wind so much in their course?"

"I suppose it is chance," answered William.

"Chance is no reason," observed his mother. "Look at the Alps, on your atlas, and I think you will find out why the rivers wind about, instead of running in a straight line to the sea. Here is the Adige, in Italy—"

"O! I see, mamma," interrupted William; "it is prevented going on straight by this mountain, for the water cannot rise up the mountain, so it is obliged to wind round it."

"Yes," said his mother, "whenever a river meets with a mountain, a hill, or any rising ground whatever, it turns aside to avoid it, and takes its course where the ground is lower. Now, as a river is constantly meeting with rising grounds, it seldom flows in a straight line for any length of time, but is continually winding either to the right or the *left.*"

"Unless," said Sophy, "it meets with rising grounds all round; then the poor river knows not what to do, but stands still, as if it were frightened; and then its waters rise high, and spread wide, and at last it is transformed into a beautiful lake. Look here," said she, pointing to the atlas; "here is the Lake of Como, and the Lake Maggiore, with some little islands in it, that look as if they could not be much larger than the island we made."

"Yet, one of them," replied her mother, "contains a splendid palace, with magnificent gardens; and another, a whole village of fishermen's houses."

"What islands do you mean, mother, and in which lake are they situated?" inquired Edward.

"The Borromei Islands," said Mrs. B., "in Lake Maggiore, in Italy. This name is given to four islands, from the fact of their belonging to the family of Borromeo, one of whom, in 1671, formed three of them by causing soil to be placed on three bare rocks, which were in the lake. Two of these are distinguished for their elegant garden grounds, and another keeps up a considerable fishing trade with Milan and Piedmont. The one known by the Italian name Isola Bella is loaded with artificial ornament. On this, is built the palace, a structure four stories high. The gardens are laid out upon ten terraces, elevated above one another, gradually becoming narrower as they rise. The whole has the appear-

ance of a pyramid with its summit cut off, and on the top is a unicorn of large dimensions, bearing the arms of the Borromeo family. Orange, citron, and lemon trees, united by fine hedges, or forming arbors, breathe their fragrance; lofty laurels form a little grove; myrtles and cypresses are to be seen, together with pomegranate and various other choice trees.

"Now, Caroline," continued she, "can you tell me whether the ground is highest at the spring where the river begins to flow, or at the sea where it ends?"

Caroline was puzzled, and after some reflection said, "I think the ground is highest on the sea-shore, because there are so many high cliffs there."

William and Edward burst out laughing. "Then, Caroline," said they, "if the end of the river is higher than the beginning, the river must run up to the sea, instead of running down to it."

Caroline colored, for she knew that rivers could not run up hill, and that she had answered wrong.

"It is true," said her mother, "that rivers descend in running, therefore the sea-shore, where the river ends, must be lower than the spring where it rises. But I shall try to puzzle these boys; can you tell me," continued she, addressing them, "which are the highest parts of Europe?"

"The mountains;" they both cried out at once.

"And yet," observed Mrs. B., "there are some mountains on the sea-shore, which you have agreed is the lowest land."

"O!" said William, "I do not mean the promontories that jut out into the sea, but the mountains in the middle of Europe, such as the Alps. I suppose Mont Blanc, which you say is the greatest mountain of the whole chain of the Alps, is the highest spot in Europe."

"It is," replied his mother, "but not the highest in the world, for there are mountains both in Asia and America more elevated.

"The highest land in Europe is towards the centre of the continent; and there, not only are the mountains highest, but the valleys between them and the plains in their neighborhood, are higher than the valleys and plains nearer the sea, otherwise the rivulets, which spring from these mountains, and flow through the adjacent valleys and plains, could never reach the sea.

"But this is not the case in every continent. In America, for instance, the chain of the Andes, one of the largest ranges of mountains in the world, runs along the western coast of South America at no very great distance from the shore, and there are, as Caroline observed, some very high cliffs on the sea-shore. Cape Teneriffe, for instance, a promontory which runs out into the sea, is above 12,000 feet high, which is only about 3,000 less than Mont Blanc."

"And I dare say," said William, "to sailors *who pass by it* at sea, Cape Teneriffe must look

higher than Mont Blanc, because they see it rising from the low level of the sea ; whilst Mont Blanc rises from the high land in the centre of Europe."

"Yes," replied his mother ; "and not only from the high land, but from a cluster of mountains, which bear it, as it were, on their shoulders."

Then, in order to show her children the comparative height of the mountains throughout the globe, she exhibited to them a drawing on which the principal ones were represented.* This at first puzzled them, as they could not understand how all these mountains could be clustered together as they were represented on the drawing ; but when their mother told them that it was done on purpose to be able to judge of their respective heights, after a little explanation, it became familiar to them.

"The line," said she, "at the bottom of the map, represents the level of the sea ; and all the mountains, valleys, towns, in a word, whatever you see above it, show their respective heights above this level." The children examined the mountains with great interest, and were astonished to see how much higher the Himmaleh Mountains in Asia were than the Alps, which, though they had never seen, they had often heard spoken of, and had supposed them to be the largest mountains in the world.

"O, mamma!" said Sophy, "pray show us Mont Blanc, which you told us was the highest of all the Alps ?"

* See Plate ; also the explanatory table, at the end of the book, *p. 296.*

Her mother pointed it out; and the children were surprised that Mont Blanc should appear so small compared with many of the other mountains.

"I wonder what this little bit of a mountain is?" said Caroline, pointing to one of the lowest in the map; and upon looking at the index, to find its name, she read Round Top. Round Top (one of the peaks of the Catskill Mountains in the State of New York) was the highest mountain that Caroline had ever seen, and she could not conceive it possible that it should appear so diminutive among its companions. "O, poor little Round Top!" exclaimed she, "which I always thought so grand;" and the color rose into her cheeks with wounded pride for her favorite mountain. She had once been carried there, and had gathered the aromatic flowers that grew in wild profusion on its sides, and she always considered its summit as an awful pinnacle she could never reach.

CONVERSATION FIFTH.

CHIMBORAZO IN SOUTH AMERICA.—MOUNT ST. BERNARD—CONVENT OF MONKS—DOGS, &C.—THINNESS OF THE AIR AT GREAT ELEVATIONS.—QUITO.—ACCOUNT OF WATERFALLS.

THE next day, the children, who had been highly gratified with the preceding conversation, promptly made their appearance, and earnestly entreated Mrs. B. to allow them to continue the examination of the map of mountains.

"What is this prodigious mountain," inquired William, "which looks as large as a dozen Mont Blancs? I think it must be the biggest mountain in the whole world!"

"It is called Chimborazo," replied his mother, "and is the largest in the chain of the Andes; it was indeed once supposed to be the highest mountain in the world, but it is now ascertained that several of the Himmaleh Mountains are higher, though none are so large at the base."

"O yes!" said William, pointing to the map; "look how much the Himmaleh Mountains overtop all the others."

"We have already," observed Mrs. B., "noticed the heights of some of the principal mountains in the world, and by reference to this Table (see Table at the end of the volume) you will learn the lengths of the principal chains."

She then showed them the chain of the Andes on the map of South America, and pointed out the spot where Chimborazo was situated. She told them that "Mr. Humboldt, a very celebrated traveller, ascended this mountain to the height of 18,000 feet, which is 3,000 feet higher than the summit of Mont Blanc, but could not reach the top. This mountain is not far distant from the town of Quito, in South America, which is situated upon a plain of such great elevation (6,550 feet) that you might suppose it to be a mountain with its head cut off; and such plains are called table-land."

"And is there no other place inhabited, which is as high?" inquired Sophy.

"Yes, there are several places in South America, much higher, as, for example, the town of Guanca Velica in Peru; and the farm-house of Antisana, New Granada, is elevated 13,500 feet above the level of the sea. In Europe, it is rare to find settlements at even half this height, and the highest dwelling-spot on that continent is less than two thirds as high. It is a convent situated at the height of 7,668 feet, on Mount St. Bernard, (in the Alps,) which is one of the passes from Switzerland into Italy, and it is inhabited by a few charitable monks, who devote themselves to travellers, who are sometimes lost in the snow, whilst crossing the mountain. These monks train up large dogs to hunt for people; and these animals show a wonderful sagacity in scratching the snow *under which* people chance to be buried; and

sometimes even in pulling them up by their clothes, in order not to hurt them, and then dragging them to the convents. The monks then use every means to restore animation, and when they are unable to succeed, they place the body upright, with its back against the wall, like a mummy, in a building they call their dead-house, in order that it may be recognised by any friends or relations who come in search of them. So slowly do the bodies decay, in consequence of the extreme cold, that they are not unfrequently recognised by their friends many years afterwards."

"These dogs must be very large and strong, observed Edward, "to be able to drag a man out of the snow."

"Yes; and a beautiful race of animals they are," replied his mother; "about the size of the Newfoundland dog. I had one of them in Switzerland, some years; but though I brought it up from a puppy it did not thrive; it suffered much in summer from the heat, and it was only in winter that it seemed to enjoy itself; and after a few years poor Alpin pined away, so that at length we were obliged to kill it, to put an end to its sufferings."

"Poor Alpin!" repeated the children.

"I wish I could have seen him," said Sophy. "I dare say we should dislike the cold of St. Bernard as much as he disliked the heat of Switzerland. Don't you think so, mamma?"

"No doubt you would; and if you remained

there any length of time,it would probably make you ill. Even the monks can seldom remain there above a few years, the cold is so intense ; for the convent is situated on the confines of perpetual snow ; that is, where the snow never wholly melts either in summer or winter ; consequently nothing will grow there, and all the provisions for the convent must be brought from the valleys below."

"I wonder the monks like to live there," said Caroline.

"They do not like it," replied her mother ; "but they devote themselves to acts of charity, and remain on this mountain solely for the purpose of relieving travellers in distress."

"Well, I should like to spend some time there," said Edward ; "there must be such excellent skating."

"There is not always excellent skating where the cold is so intense. There is seldom skating in Canada later than the end of October, because, as winter comes on, the ice becomes so thickly covered by successive falls of snow, that the skates cannot reach it ; and consequently skating is impracticable."

"Have you ever been on Mount St. Bernard, mamma ?"

His mother said she had once attempted to ascend the mountain, but having gone as far as Lyde, a village about half way up, she found the thinness of the air disagree with her so much, that *she did not venture* any further.

"Is the air bad upon that mountain?" inquired William; "I thought that the air on hills and mountains was better than on low grounds. Don't you remember, mamma, after the measles, the Doctor advised the taking of us to some elevated spot in the country, for the sake of the good air there?"

"The air in any elevated situation is more pure, because it is less mixed with fogs from the earth; but in proportion as you ascend, the air becomes thinner, and on very high mountains it is so thin or rare that it is difficult to breathe, the blood is liable to be forced out from the face and other parts of the body, as many instances are known of travellers having thus suffered."

"I should have thought," said Sophy, "that the thinner the air was the more easily it could be breathed."

"Then, do you think," said Edward, laughing, "that it would be most easy to breathe if there were no air at all?"

"No;" replied Sophy, coloring; "I know that we must have some air to be able to breathe, but thin air is very different from no air at all."

"Very true," said her mother. "Now, as a much greater number of the inhabitants of the earth live on the plains not much raised above the level of the sea than upon the tops of high mountains, it is very natural to suppose that God Almighty, who is so wise and so good to us, would place the air, which was best to be breathed, in those situations that are most habitable, and so we find it; for *the air which is* not much raised above the

level of the sea is that which is most easily breathed."

"And is it as cold in the town of Quito in South America as it is at the Convent of St. Bernard?" inquired Sophy.

"O, no!" replied her mother; "if you look at the map of South America, you will see that the town of Quito is situated in the torrid zone, which is much hotter than any other part of the globe. Therefore, though Quito is at about the same height from the level of the sea as St. Bernard, it is very far from being near the confines of eternal snow. It requires a much greater elevation in the torrid zone for snow to remain frozen all the year through; and the town of Quito, instead of being a bleak waste like St. Bernard, where scarcely any vegetation takes place, and no crops will grow, is surrounded by a vegetation much more profuse and luxuriant than we have here; and it is very pleasant to live in an elevated spot, and breathe cool air in such a region."

"I think there ought to be a map of all the cascades," said Caroline; "I should like to see them all together, to judge of their comparative heights."

"But not to hear them," said Sophy, "for we should be stunned with their noise."

"One of the greatest of these cataracts," said Mrs. B., "is the Staubbach in Switzerland. It is much more remarkable for its height than for the quantity of water. This fall is so perpendicular, and the height so great, (1,400 feet,) that

the water leaves the rock from which it is precipitated and falls in the air, and the whole of it is converted into a sort of misty vapor before it comes to the ground. A considerable portion of this vapor is dispersed by the wind, and finally reaches the earth in the form of dew."

"It must present a very singular appearance," observed William, "and one that I should greatly rejoice to see."

"Perhaps you may, my child, one of these days," remarked Mrs. B., "and that without travelling to such a distance as Switzerland."

"How so, mother?" inquired the children.

"By going with your papa as far south as Georgia. On a stream, called Tockoa Creek, which flows from the Cunawhee Mountain, (that forms a part of the great Alleghany ridge,) is a fall, which, to be sure, is but little more than one seventh as high as the Staubbach, but the phenomenon it exhibits is much the same; for in ordinary seasons its water, instead of being precipitated in one sheet, is divided into several small streams, which become spray before the bottom is reached."

"Mother, if the Tockoa stream rise in a mountain, I do not see how it can be called a *creek*," observed William; "for my geography says that a creek is a narrow inlet of the sea, or a portion of the sea making into the land."

"Your geography is correct, William. The applying of this term to rivers, although not uncommon, *is a very improper* use of it."

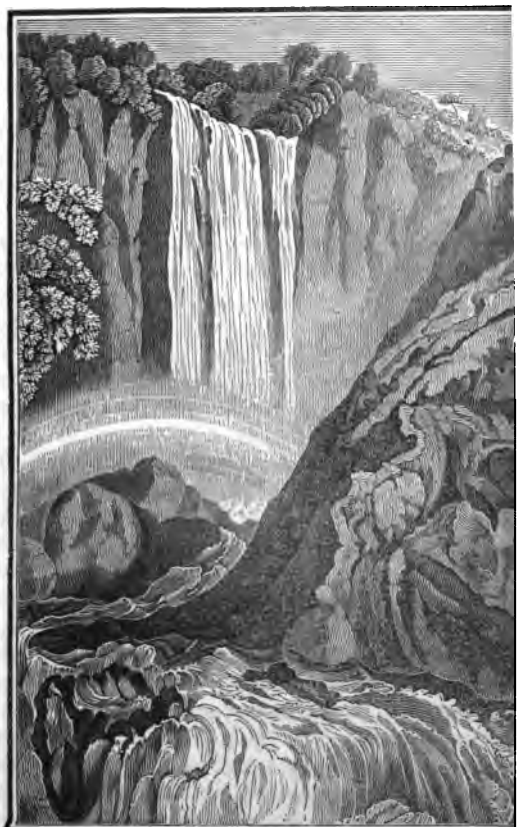
"Will you tell us something more about falls, and cataracts, and the like?" asked little Cary.

"With pleasure, my dear. But first, William, can you tell us the meaning of cataract, and falls?"

"Yes, mother. All sheets of water that pass down sudden or abrupt descents, may be called falls. If these descents be precipices, the falls are called *cataracts*; if they consist of successive steps, *cascades*."

"Very well explained," said Mrs. B.; "but to return to our subject: there is another of these spray-forming falls in the river Ache, Bavaria; the whole descent is two hundred feet, by five successive steps, and the water is entirely converted into spray. So powerful is the current of air there, as to forcibly drive back the spectator, who may attempt to approach the brink of the gulf, and the roar of the water is often heard some miles off. In the Alpine regions of Europe there are numerous waterfalls. Among these, may be mentioned the cataract near Schaffhausen on the Rhine, which is four hundred and fifty feet broad and seventy feet high. This is spoken of by those who have visited it, as possessing much grandeur.

"Norway, Sweden, and Scotland abound in waterfalls. One of the largest falls in Europe is situated in Swedish Lapland, on the river Lattin; we are told it is four hundred feet high and half a mile wide. Few, if any falls, have been more celebrated, both in prose and verse, than those of Terni and Tivoli in Italy. The former are about forty-five miles north of Rome, and are



Cascade of Terni.

formed by the rushing of the Velino over a precipice of rocks three hundred feet in height; these are of marble, and hence the fall has received the appellation of the *Marble Cascade*. It is this fall of which Byron has given such an impassioned description; in the course of which he exclaims,

"'Lo! where it comes like an eternity,
As if to sweep down all things in its track,
Charming the eye with dread—a matchless cataract.'

But all of these, and many others that might be named, are worthy of note on account of their height only, and not from their quantity of water. If we wish to behold a water scene in all its matchless grandeur, awful sublimity, and wild magnificence, we must seek for it nearer home, for America, in this respect, stands pre-eminent over the rest of the world."

"How glad I am," cried little Cary, "for I began to think, mother, that we had no falls except in Georgia, as you said nothing more about our country."

"O yes! my dear, the whole continent of America may be said to abound in falls, and particularly true is this of the United States. Among the great number that might be mentioned, we have time only to name Bellows Falls on the Connecticut River, Glen's Falls on the Hudson River, described, among other writers, by our countryman Cooper, Falls of the Genesee, Cohoes Falls on the Mohawk, the Falls on the Housatonic, pronounced the finest in New England, the Passaic Falls, the

Falls on the Missouri, which, in the short distance of eighteen miles, have a descent of three hundred feet. The grandeur of this scene is reported to be unsurpassed by any thing of the kind, with but one exception."

"What one is that, mother?" asked the children.

"As it is one deserving of something further than a passing allusion to it," she replied, "I will reserve my remarks upon it, for our next conversation.

"One of the most interesting spots, as respects land and water scenery combined, that I have ever had the pleasure of visiting, is in the State of New York, about fourteen miles north from Utica, and is known as the Trenton Falls. Here, for the distance of two miles, there is a continual succession of varied prospects, presenting to the eye numerous gradations, from the wild, tumultuous, rushing torrent, to the beautiful cascade, and the placid, gentle stream; from the dense and sombre forest, to the gently-undulating hill, and verdant plain. A description of no one portion of the Falls will convey a correct idea of the whole, and time will not allow of my attempting to portray all of their peculiar features. I will, however, give you, from a beautifully-illustrated work,* now in the course of publication, a description of a moonlight view down the 'ravine,' written by N. P. Willis, Esq. 'The moon rose about ten,

* 'American Scenery,' published by Martin & Co., New *York.*

and lifted her perfect orb, without a mist or a cloud, over the shoulder of the mountain, which turns the outlet of the ravine. The fine and majestic wood, through which winds the narrow foot-path to the Falls, let in the white light in silvery and broken masses—sometimes sliding a leer down the dark body of a pine, sometimes pouring in upon the horizontal branches of the hemlock, like an open hand sprinkled with snow, and here and there lighting up a broad circle upon the carpet of tassels and dead leaves, which, in contrast with the heavy shadows of the surrounding wood, looked illuminated with the special brightness of a fairy ring.

"'We descended the long ladder leading into the ravine, and were soon below the reach of the moonlight, which came aslant as yet, and only rimmed the black wall above us with a long strip of white, which, where the wavy line of moss and creepers ran into it, resembled the edging of lace upon a velvet coat in a dark old Flemish picture. The water in this part of the gulf quite fills up the chasm, and rolls, even by daylight, in a black and sullen stream between the bare cliffs which frown over it. The only path here is a giddy ledge, half way up the precipice, which is passed with the aid of a chain run along the rock; and as we stood on this, looking over into the uncertain darkness below, with the murmur of the far down and invisible current ascending faintly to our ears, and the light of heaven ceasing so far above us,'—the effect *was awfully* grand and impressive.

'We crept on till we came to the foot of the principal Fall, and sat down on the platform below, to wait the gradual descent of the moon.

"'The mist over the Fall began to show like a film of gauze waving in the air; the sharp angles and crevices in the precipice caught the line, one by one, and soon the whole upper ravine was illuminated, while through the gorge below the stream still made its way, darkly and suddenly, to the outlet.

"'No pencil, no language, can describe the splendor with which the moon threw her light across the face of the Fall. The other objects in the ravine drank her beams soberly, and gave back only their calm outlines to the eye; but, from this wall of waters, every spray-drop gave back a diamond—every column of the descending element, a pillar of silver.'

"I will close our present conversation, by repeating to you a singular and sprightly description of a waterfall, written by Robert Southey, a celebrated English poet.

"'How does the water come down at Lodore?
Here it comes sparkling,
And there it lies darkling;
Here smoking and frothing,
Its tumult and wrath in,
It hastens along, conflicting strong;
Now striking and raging,
As if a war waging
Its caverns and rocks among.

Rising and leaping,
Sinking and creeping,

Swelling and flinging,
Showering and springing,
Eddying and whisking,
Spouting and frisking,
Turning and twisting,
Around and around,
Collecting, disjecting,
With endless rebound ;
Smiting and fighting,
A sight to delight in,
Confounding, astounding,
Dizzying and deafening the ear with its sound.

Receding and speeding,
And shocking and rocking,
And darting and parting,
And threading and spreading,
And whizzing and hissing,
And dripping and skipping,
And whitening and brightening,
And quivering and shivering,
And hitting and splitting,
And shining and twining,
And rattling and battling,
And shaking and quaking,
And pouring and roaring,
And waving and raving,
And tossing and crossing,
And flowing and growing,
And running and stunning,
And hurrying and skurrying,
And glittering and flittering,
And gathering and feathering,
And dinning and spinning,
And foaming and roaming,
And dropping and hopping,
And working and jerking,
And guggling and struggling,
And heaving and cleaving,
And thundering and floundering,

And falling and brawling and sprawling,
And driving and riving and striving,
And sprinkling and twinkling and wrinkling,
And sounding and bounding and rounding,
And bubbling and troubling and doubling,
Dividing and gliding and sliding,
And grumbling and rumbling and tumbling,
And clattering and battering and shattering,

And gleaming and streaming and steaming and beaming,
And rushing and flushing and brushing and gushing,
And flapping and rapping and clapping and slapping,
And curling and whirling and purling and twirling,
Retreating and meeting and beating and sheeting,
Delaying and straying and playing and spraying,
Advancing and prancing and glancing and dancing,
Recoiling, turmoiling, and toiling and boiling,
And thumping and flumping and bumping and jumping,
And dashing and flashing and splashing and clashing.

And so never ending, but always descending,
Sounds and motions for ever and ever are blending,
All at once, and all o'er, with a mighty uproar—
And this way the water comes down at Lodore.' "

Falls of Montmorenci.

CONVERSATION SIXTH.

WATERFALLS.—FALLS OF MONTMORENCI.—CHAUDIERE FALLS.—CATARACT OF NIAGARA.

THE next day, Mrs. B. observed, "There are two American Falls, which, though not situated in the United States, I should not omit to mention. They are both in Canada, which, by looking at the map, you will see lies north of us. One of the Falls is nine miles below Quebec, on the river Montmorenci, and at some seasons of the year, a truly magnificent spectacle is here presented. The water rushes down a precipice, from a height of 220 feet, and exhibits a vast body of snow-white foam. Falling with great impetuosity upon the surface of the river below, a considerable portion of it recoils into the air in the form of spray or vapor; and in the winter the vapor, freezing in the air, is converted into snow or sleet, and falls again in that state."

"How curious that must be!" said Sophy; "I should like to see a waterfall of snow."

"There is another circumstance, that renders it still more curious," continued Mrs. B.; "the cold, which freezes the spray, freezes the river beneath, so that the snow falls on the ice, which sustains it, and it accumulates, and rises in the form of a *sugar-loaf* to a great height, and is so

steep that the ascent is very difficult, and if you reach the top there is no way of getting down again but by sliding in a sitting position."

"That would be good fun," cried the children.

"The other Falls are in the vicinity of these, and are known by the name of the river (Chaudière) in whose course they occur. In height, they are about half the elevation of the Montmorenci, but are well worthy of a visit on account of the surrounding scenery. Many of the falls in mountainous districts," continued their mother, "are not high, but they are grand, from the immense body of water precipitated."

"I wonder that the greatest cataracts should not be in the highest mountains," said William.

"Mountains," said his mother, "abound with small cascades, owing to the precipitous nature of the ground. They may be perpendicular, but they cannot consist of a large body of water, for a large body of water can be collected only from the union of a great number of streams after they have descended from the mountains, and are winding through the valleys in the form of rivers, to find their way out through the plains into the sea; and when in their course they are joined by other rivers, a much more considerable body is formed than can be found among mountains."

"Certainly," said William, "the greatest quantity of water in a river must be where it ends; not in the mountains where it begins. But are there no cataracts falling into the sea? How *beautiful that would* be!"

"I do not know a single instance of a river falling precipitously from a high cliff into the sea," said his mother.

"It cannot be for want of high cliffs to fall from, I am sure," said Edward, "for there are plenty of them by the sea-side."

His mother observed, that "rivers are apt to be frisky in their early days, when they are but little rivulets, leaping about from rock to rock, and rushing from some stupendous projection perpendicularly to the ground; but that, as they advance in life, they become much more steady and prudent, winding cautiously through the valleys, and going a long way round, rather than dashing about as they did in the days of their youth."

The children laughed heartily at their mother's comparison. "O yes!" said Cary; "rivers are grown-up rivulets, and rivulets are but little children."

"But, mamma," said William, "as rivers cannot really be prudent, nor rivulets giddy, what is it that makes them appear so?"

"A very proper question," replied his mother, "without which, my metaphor might have led the oldest of you into error. We have already observed that rivulets which flow in mountainous parts are often precipitated from great heights, owing to the very unequal nature of the ground. When they reach the valleys, they are in much less danger of such violent falls, and generally flow on, quietly winding round the mountains,

till they reach the open country. There they have still less chance of being precipitated ; yet it sometimes occurs, as in the case of that noble river the Rhine, which, in the midst of a flat country, suddenly dashes down a considerable declivity with great violence, and, as the Rhine is a full-grown river, (as Cary says,) the cataract formed by so large a body of water, is magnificent."

"So, then," observed William, "the smallest but most perpendicular falls are among the mountains, and the largest in the plains."

"But, mother, pray tell us about the big Falls that you yesterday promised to speak of at our next conversation," exclaimed Cary, and Sophy, and Willy, all at once.

"The Falls to which I alluded," said Mrs. B., "are those of Niagara, which make a part of the northern boundary between the United States and Canada. Although I have more than once visited them, and gazed hour after hour, and day after day upon them, with mingled emotions of wonder and astonishment, I am fully sensible that any description that I might attempt would convey but a feeble idea of them. As has been truly remarked by our distinguished countryman, Audubon, the celebrated naturalist, 'all the pictures you may see, all the descriptions you may read, of these mighty Falls, can only produce in your mind the faint glimmer of the glow-worm, compared with the overpowering glory of the meridian sun.' Father Hennepin, a missionary, who

travelled in this country in 1678, says, 'Betwixt the Lakes Ontario and Erie, there is a vast and prodigious cadence of water, which falls down after a surprising and astonishing manner, insomuch that the universe does not afford its parallel. 'Tis true, Italy and Suedeland boast of some such things, but we may well say they are but sorry patterns, when compared with this of which we speak.'

"Messrs. Reed and Matheson, two ministers, who came here on a visit to the Baptist churches, published, on their return to England, 'A Narrative of a Visit to the American Churches;' in which are the following remarks about Niagara. 'I have been particular in my account of these Falls, because the world knows nothing like them.' 'I have seen many falls, and with unspeakable delight, but nothing to be named with this. It would, in parts, present images of them all; but all, united, would not supply a just idea of it. It is better to see it than a thousand ordinary sights; they may revive sleeping emotions, and so bring delight; but this creates new emotion, and raises the mind a step higher in its conceptions of the power and eternity of Him, whom "to know is life eternal." The day on which it is seen, should be memorable in the life of any man.' I might spend the time allotted to many conversations in relating to you the remarks and opinions of celebrated writers respecting Niagara, and yet the half would not be told you. Indeed, to do any thing like ample *justice* to the subject, it would

require a volume of many pages. So varied is the scene presented to the beholder, according to the spot from which he takes his view, the aspect of the weather in which he beholds it, and the season of the year during which he visits it, that it is difficult to decide under what aspect, from what position, or at what season, it may best be described. Each has its peculiarities, but all will fill the mind with wonder and with awe.

"One of the most beautiful, graphic, and truly poetical descriptions I have ever met with, is from the pen of the Rev. Dr. Greenwood, of Boston; its great length, (although, considering the writer, and the subject, it is by no means too long for the gratification of the reader,) prevents my making you acquainted with it now, but, at some leisure time, Edward may read it to us."

"But how is Edward to get it?" inquired Sophy, who was very desirous of learning all that she could about Niagara.

"He will find it in the Token, for 1832," replied Mrs. B. "There is another description, contained in a letter from the Rev. Mr. Bascom to a friend, and with a perusal of which I have been favored through the pages of the Knickerbocker, that I will communicate for your gratification and instruction. Mr. B. writes—

"'My dear E——: I have seen, surveyed, and communed with the whole!—and, awed and bewildered, as if enchanted before the revealment *of a mystery*, I attempt to write. You ask

View of the Schlosser Fall, from below, with the Great Horseshoe Fall in the distance.

me in your last for some detailed, veritable account of the Falls, and I should be glad to gratify you; but how shall I essay to paint a scene that so utterly baffles all conception, and renders worse than fruitless every attempt at description? In five minutes after my arrival, on the evening of the fifth, I descended the winding path from the Pavilion, on the Canadian side, and, for the first time in my life, saw this unequalled cascade from Table Rock; the whole indescribable scene, in bold outline, bursting on my view at once. I had heard and read much, and imagined more, of what was before me. I was perfectly familiar with the often-told, the far-travelled story of what I saw; but the overpowering *reality* on which I was gazing, motionless as the rock on which I stood, deprived me of recollection, annihilated all curiosity; and, with emotions of sublimity, till now unfelt, and all unearthly, the involuntary exclamation escaped me, "*God of grandeur! what a scene!*"

"'But the majesty of the sight, and the interest of the moment, how depict them? The huge amplitude of water, tumbling in foam above, and dashing on, arched and pillared as it glides, until it reaches the precipice of the *chute*, and then, in one vast column, bounding, with maddening roar and rush, into the depths beneath, presents a spectacle so unutterably appalling, that language falters; words are no longer signs, and I despair giving you any adequate idea of what I saw and felt. Yet this is not all. The eye and the mind necessarily take in *other objects*, as parts of the grand

panorama; forests, cliffs, and islands; banks, foam, and spray; wood, rock, and precipice; dimmed with the rising fog and mist, and obscurely gilded by the softening tints of the rainbow. These all belong to the picture; and the effect of the whole is immeasurably heightened, by the noise of the cataract, now reminding you of the reverberations of the heavens in a tempest, and then of the eternal roar of ocean, when angered by the winds.

"'The concave bed of rock, from which the water falls, some two hundred feet, into the almost boundless reservoir beneath, is the section of a circle, which, at first sight, from Table Rock, presents something like the geometrical curve of the rainbow; and the wonders of the grand Crescent, thus advantageously thrown upon the eye in combination, and the appropriate sensations and conceptions heightened by the crash and boom of the waters, render the sight more surpassingly sublime, than any thing I have ever looked upon or conceived of. As it regards my thoughts and feelings at the time, I can help you to no conception of their character. Overwhelming astonishment was the only bond between thought and thought; and wild, and vague, and boundless, were the associations of the hour! Before me, the strength and fulness of the congregated "lakes of the north" were enthroned and concentrated, within a circumference embraced by a single glance of the eye.

"'Here I saw, rolling and dashing, at the rate *of twenty-five* hundred millions of tons per day,

nearly one half of all the fresh water upon the surface of the globe! On the American side, I beheld a vast deluge, nine hundred feet in breadth, with a fall of one hundred and eighty or ninety, met, fifty feet above the level of the gulf, by a huge projection of rock, which seems to break the descent and continuity of the flood, only to increase its fierce and overwhelming bound. And turning to the Crescent, I saw the mingled rush of foam and tide, dashing with fearful strife and desperate emulation—four hundred yards of the sheet rough and sparry, and the remaining three hundred a deep, sea-like mass of living green—rolling and heaving like a sheet of emerald. Even imagination failed me; and I could think of nothing but ocean let loose from his bed, and seeking a deeper gulf below! The fury of the water, at the termination of its fall, combined with the columned strength of the cataract, and the deafening thunder of the flood, are at once inconceivable and indescribable. No imagination, however creative, can correspond with the grandeur of the reality.

"'I have already mentioned, and it is important that you keep it in view, the ledge of rock, the verge of the cataract, rising like a wall of equal height, and extending in semicircular form across the whole bed of the river, a distance of more than two thousand feet; and the impetuous flood, conforming to this arrangement, in making its plunge, with mountain weight, into the great Horseshoe basin beneath, exhibits a spectacle of the sublime, in geographical scenery, without per-

haps a parallel in Nature. As I leaned over Table Rock, and cast my eye downward upon the billowy turbulence of the angry depth, where the waters were tossing and whirling, coiling and springing, with the energy of an earthquake, and a rapidity that almost mocked my vision, I found the scene sufficient to appal a sterner spirit than mine; and I was glad to turn away and relieve my mind by a sight of the surrounding scenery—bays, islands, shores, and forests, every where receding in due perspective. The rainbows of the Crescent and American side, which are only visible from the western bank of the Niagara, and in the afternoon, seem to diminish somewhat from the awfulness of the scene, and to give it an aspect of rich and mellow grandeur, not unlike the bow of promise, throwing its assuring radiance over the retiring waters of the Deluge.

"'The "rapids," which commence nearly a mile above the cataract, and, sparkling in the sun, spread out, before the eye, like a sea of diamonds, seem admirably to give notice of what awaits below; and when examined from a position on Goat Island, become extremely interesting, from the dash and foam of the broken flood, the noise of which, distinct from that of the great Fall, would remind you of the lofty murmurs of an Alpine forest, in the rising swell of the coming storm. In crossing the river below the Falls, you have one of the richest views of the whole cascade, that can possibly be imagined; and the rising *bank* and mossy rock, the lofty trees and lux-

uriant shrubbery on either side, are in fine keeping with the scene, and are essential to the unity and completeness of the picture. But what most interested me here, was the tumultuous tossing and whirling of the water, where its depth must be more than two hundred feet, and its width at least seven hundred yards. The whole mass seems to be heaving with infuriate life. A thousand counter currents and eddies meet, break, and mingle, in the general "torrent and whirlwind" of the waters. Within a circumference of two or three hundred yards, near the American shore, this singular action of the element gives the water an elevation of from five to seven feet, above the ordinary level, and the strong conflicting currents are seen tossing and struggling with volcanic force, like the Adriatic turned up from the bottom by a tempest.

"'But the most appalling combination of wonder and awe was felt, when, after descending the spiral staircase at Table Rock, I passed under the great falling sheet. Divesting myself of the more burdensome part of my clothes, and girding an oil-cloth mantle about me, with a hood for the protection of the head, I entered the hollow space, half luminous, half obscure, between the projecting rock and the boundless mass of water pouring over its arch, like a sea of molten lead. In this way I proceeded one hundred and fifty or sixty feet, to "Termination Rock," a point beyond which no human being has ever penetrated; and here, amid a tempest of wind and spray, almost

depriving me of respiration, I paused to look up and around, awed and agitated by the stirring grandeur and sombre mysteriousness of all I could hear or see !

" ' The edge of the precipice, over which the water falls, is a projection of about fifty feet over the base where I stood. After remaining here for several minutes, and selecting some pebbles from the path at my feet, with an increased sense of danger, I effected my retreat, sincerely thankful, that I had not purchased the gratification of my curiosity with the loss of my life. I spent four days and nights, with the exception of a few hours for rest, in the examination of the Falls, and in solitude with the majesty of the engrossing scene—a majesty all its own—untyped and unshadowed by aught I had ever seen before ; and having surveyed the great object of my visit from nearly a hundred different points of view, I was more than satisfied, that the Cataract of Niagara is a wonder in Nature, wholly unique in its kind, and affording a rich, if not an unequalled harvest, of interest and observation, to every beholder. Indeed, Nature seems to have done her work here in a mood and upon a scale of the most creative prodigality ; consulting alike, as the pagan poet would say, "her own amusement, and the admiration of man."

" ' My last look at the Falls was a night view, from the upper portico of the Pavilion ; the brilliant lamps and mooned loveliness of an autumnal *heaven* adding to the splendor of the vision.

From this point, amid the tremulous shaking of the earth and the heavens, in silent communion with the mighty cataract, the eye takes in a more extended range—the most magnificent of prospects. The whole scenery, diversified and yet one, is spread out before you in living beauty and picturesque majesty. You see the plains and forests above, the cliffs, and rocks, and islands around; the dreadful precipice, and the bold sweep of the watery mass, while the fall of the vast pervading column strikes your ear like the thunder-chorus of the "vasty deep," warring with its bounds!

"'I felt about me a heart-reaching, spirit-stirring influence, that detained me until midnight; and when I retired, fatigued and exhausted, and threw myself upon my pillow, it was only to feel the more intensely the power and expression, the oneness, the depth, the nameless grandeur, of the scene; and ear and thought still lingered to catch and commune with the far-off chidings of the flood, as they wailed to the one the requiem of departed waters, and murmured to the other the melancholy dirge of their passing away.'

"This description is in the main correct. Instead of American side, however, I would substitute New York, the whole Falls being in America. Writers, in speaking of the Falls, very often designate the United-States side as the American. Mr. B.'s description of the cataract has reference particularly to the views presented from the

Canada side; but some of the most splendid and interesting ones are upon the New-York side, and are spoken of by Dr. Greenwood, in the description I have already alluded to. The Schlosser Fall, mentioned by Mr. B. as the American Fall, is one hundred and sixty-seven feet, instead of one hundred and eighty or one hundred and ninety feet, in descent. Finally, the rainbow may be seen from both sides, and from all parts, provided the spectator is facing the Falls, with his back to the sun, though it is seen in all its splendor from the New-York side only in the forenoon, and the Canada side only in the afternoon."

"How I should admire to see this mighty cataract," exclaimed Sophy.

"What nice fun it would be," said William, "to cross the river, as Mr. Bascom did, at the very foot of the Falls."

"What a noble sight it must be," observed Edward, "to behold, from Table Rock, the immense mass of waters rolling along and precipitating itself over the Horseshoe."

"How I should like," remarked William, "to pass under the Horseshoe, and watch this great volume, as, curving over the brink of the precipice, high above, it dashes like a vast shower-bath into the gulf below."

"I should prefer," replied Edward, "to enter the 'Cave of the Winds,' behind the Central Fall, which I remember Mr. Ingraham mentioned in one of his lectures on Niagara. I shall never *forget the splendid* pictures with which he illus-

trated his subject. I wish he had shown us the interior of the Cave of the Winds."

"Cave of the Winds!" exclaimed Cary, "the winds are not kept packed away there, are they, mother?"

"They are at all times found to prevail there," said Mrs. B., "and this name, given it by Mr. Ingraham, was suggested to him, he tells us, by Virgil's description of the Cave of Æolus, who was the fabled god of the winds; for here is, literally, 'a place pregnant with boisterous winds,' if not as literally, 'the native country of storms.' 'Here, King Æolus, in a vast cave, controls by his authority, and restrains with chains and in a prison, the struggling winds and the roaring tempests; while they, indignant at their captivity, roar around the barriers of their prison, and the whole region shakes with the great murmur of the mountain.'

"Mr. I. is completely wedded to the Falls, and is a perfect enthusiast in all that relates to them; he has devoted much time and no little industry to an investigation of their history, and an examination of their phenomena; he has made himself familiarly acquainted with every thing of moment at or in the vicinity of this great wonder of the western world. Being anxious that others should have it in their power to become acquainted with, and to enjoy, the beauty and magnificence which Nature has on so grand a scale here displayed, he has published a little guide, with which all visiters should supply themselves."*

* 'A Manual *for the Use* of Visiters to the Falls of Niagara. *By Joseph Wentworth* Ingraham.'

"The time allotted to our conversation has expired, and we must take leave of Niagara. I know not how I can better close my remarks, than in the following expressive lines of Brainard, which so clearly manifest that the poet, whilst beholding the scene described, did not fail 'to look through Nature, up to Nature's God.'

"'The thoughts are strange that crowd into my brain,
While I look upward to thee. It would seem
As if God pour'd thee from his hollow hand,
And hung his bow upon thine awful front;
And spoke in that loud voice, which seem'd to him
Who dwelt in Patmos for his Saviour's sake,
"The sound of many waters;" and had bade
Thy flood to chronicle the ages back,
And notch His centuries in the eternal rocks.

"'Deep calleth unto deep. And what are we
That hear the question of that voice sublime?
O! what are all the notes that ever rung
From war's vain trumpet, by thy thundering side!
Yea, what is all the riot man can make
In his short life, to thy unceasing roar!
And yet, bold babbler, what art thou to Him
Who drown'd a world, and heap'd the waters far
Above its loftiest mountains?—a light wave,
That breaks and whispers of its Maker's might.'"

CONVERSATION SEVENTH.

COMPARATIVE MAP OF RIVERS.—LARGE SCALE OF NATURE IN AMERICA.—RIVERS AMAZON AND GANGES COMPARED.—RIVERS IN EUROPE.—BOUNDARIES OF COUNTRIES MARKED OUT BY THE DIRECTION OF RIVULETS.—SIZE OF RIVERS GENERALLY CORRESPONDING TO THEIR LENGTH.—RIVERS FLOWING THROUGH VALLEYS INTO BASINS.

At the commencement of the conversation on the following day, Mrs. B. showed her children a comparative map of the principal rivers. They examined it with great interest.

"I am sure," said Sophy, "the real rivers must wind about much more than they do here in the map; for they run so straight that you would suppose they never met with a rising ground to turn them out of their way."

"If their course were described as winding as it really is in Nature," replied her mother, "it would have been impossible to have delineated them in the map; but their proportional lengths are exactly preserved."

"Let me see," said William, "which is the longest. It is the River Mississippi, if we follow up its main branch, the Missouri; and next to that the River Amazon, another American river! So that North America can boast of possessing the

first, and South America the second river in the world. Well," continued he, with a look of surprise, "they have neither mountains, nor cascades, nor rivers, nor any thing of the largest size in England, although, from the sneers of many of her captious travellers, one would suppose every thing was on the grandest scale *there*, and on the most diminutive *here*."

"You must not rely too much upon the accounts of itinerants who publish works, not to communicate knowledge or truth, but as a means of putting money in their pockets. Consult works of established reputation, issuing from sources of responsibility and acknowledged worth, and you will never be misled on such points. England makes up for these deficiencies by her perfection in the useful arts. There is no country more celebrated for its machinery and manufactures than England; and it is a fair inference that a people must be very wise and highly industrious, who make so many, and in a great degree, such excellent things. But though England is beautiful, and its vegetation luxuriant, we must look to other countries for natural grandeur. America may boast not only of the largest rivers, but its vegetation in general is on a more magnificent scale; the trees are both larger and taller; the forests of immense extent; in short, the New World seems to be of a more gigantic stature than the Old one."

"So, then," said Sophy, "the New World has outgrown the Old one, like a daughter who grows *taller than her mo*ther."

"All the countries in the world, my dear, you must remember, are of the same age, having been created at the same time; and America is called the New World only because it has been newly discovered, or rather was rediscovered, (in 1492,) nearly three hundred and fifty years ago."

"But why, mother, do you say rediscovered?" asked Edward; "this Country certainly was not known previous to the time of Columbus, was it?"

"The generally-received opinion has been that it was not," replied Mrs. B.; "but a recently-published work of a very learned Society in Copenhagen, satisfactorily shows, as the result of their investigations, carried on for a series of years in Europe and this Country, that America was discovered as early as 982, and was visited by various voyagers, from Greenland and Iceland, for many years in succession, during a considerable period, and even to within a century of the time that Columbus flourished. But our present purpose is to view Scenes in Nature, and not to study events in History, therefore we cannot pursue this interesting subject further."

"The highest *mountains*," said William, "are not in America, for the Andes are lower than the Himmaleh Mountains in Asia. And I wonder," added he, after a little reflection, "that the highest mountains should not produce the largest rivers, for you know the higher the mountains, the further the rivulets will have to descend, whether they flow outside or inside the mountain, so the

greater will be the number and size of them to make a river."

"But," observed his mother, "the rivulets do not descend merely to the foot of the mountain. When united together, to form a river, it must find its way to the sea; and the more country it passes over before it reaches the sea, the greater will probably be the number of streams that will join it in its course. Now, the river Amazon, which crosses the whole continent of America, and is no less than seven hundred leagues in length, traverses a much greater extent of country than the Ganges, before it reaches the sea." And Mrs. B. pointed out to her children, on the globe, the course of the Amazon, which takes its rise near the city of Lima; and that of the Ganges, which flows from the Himmaleh Mountains.

"But, mamma," said Edward, "the River Amazon would have had but a very short way to go if it had run into the Pacific Ocean, instead of crossing the whole, and the widest part, of the continent of South America, to fall into the Atlantic Ocean."

"The river," replied his mother, "has no choice, but must flow where the ground descends. Now, since the River Amazon takes its rise on the eastern side of the Andes, it could not get to the western side of that range of mountains without flowing upwards, which you know is impossible; it must, therefore, continue its course on the same side of the mountain as that on which the spring *first gushes from* the ground."

"And besides," said William, "the use of a river is not to fall into the ocean, where it is lost, but to water the country it runs through, and make the grass, and corn, and trees grow."

"Very true," said his mother, "and it is wisely ordered, that the river takes the longer course instead of the shorter one, for it waters and fertilizes an immense tract of country before it falls into the Atlantic Ocean; whilst, if it had flowed westward, it would have been scarcely of any use, being so soon swallowed up by the Pacific Ocean.

"There are, however, many rivers which take this latter direction, but I should call them rather torrents than rivers; for, having to descend from these high mountains to the level of the sea in so short a space of country, they roll along with prodigious impetuosity. In the neighborhood of the equator, the Andes are not above two hundred miles from the sea, and during this space the rivers descend nearly ten thousand feet; their velocity is therefore very great, but far from uniform, as they are frequently precipitated in cascades."

Mrs. B. next showed her children the map of Europe, and told them to observe that the rivers which take their rise in the Alps do not all run into the Mediterranean. "The Rhine," said she, pointing it out to them, "directs its course to the German Ocean, because it springs up on the northern side of the Alps. It is for this reason that, on crossing a mountain, all the little rivulets flow down towards you; but no sooner do you pass the *summit*, and begin to descend on the

other side, than the rivulets flow on before you. In traversing the Simplon, they seemed to me like so many playful children, who, while frisking and gambolling about, were leading me into Italy.

"The same you will find to be the case in travelling over the Alleghanies, should you ever cross those mountains on your way to Pittsburg and other thriving cities of the west, which, almost magic-like, have sprung up in such numbers within a few years past."

"O, yes! I understand that," said Sophy; "rivulets must flow downwards; so, when you go up the Simplon they come down in a very friendly manner to meet you; but no sooner have you reached the top, than they run away from you."

"You must, however, observe," said her mother, "that these are two different sets of rivulets; those which flow towards Switzerland, taking their rise on the northern side of the mountain, and those which descend in Italy on the southern side; for the same rivulet cannot flow both ways."

"But supposing a spring were to gush out from the very top of the mountain," said Caroline, "which way would it flow?"

"If I were the spring," said Sophy, "I should choose Italy: but then I have heard that Switzerland is a very beautiful country too."

"You need not trouble yourself about the choice, Sophy," said William; "for no spring could gush out at the top of a mountain. Where *would* it come from, pray? a reservoir of water in

the air ? for you know the spring must lie always lower than the reservoir whence it flows."

"That is true," said his mother; "but there is a reservoir of water in the air, William, and that is rain, which, though it does not produce springs, gushing out from under ground, produces a great many rivulets, flowing down the surface of the mountain, the direction of whose course is determined by the ridge which forms the summit. Every drop which falls to the north of this imaginary line descends towards Switzerland ; every drop which falls to the south of it flows towards Italy.

"The different course of these rivulets," continued Mrs. B., "often serves as a boundary to separate countries. For instance, the Pyrenees, you know, divide France from Spain ; but what part of this chain do you suppose belongs to France, and what part to Spain ?"

"I think," said Edward, "that it would be fair that all that side of the chain of mountains towards France should belong to that country, and that the opposite side should belong to Spain ; so the line which separates the two countries should run along the ridge at the top of the mountains."

"True ; yet it would be difficult to make out exactly which was the highest ridge along a chain of mountains that is very irregular, if it were not for the course of the rivulets ; but these mark it out precisely."

"And is this the way the line is drawn be-

tween all countries separated by mountains ?" inquired Edward.

" I am sorry to say that it is not," replied his mother. " The chain of the Jura rises between France and Switzerland ; but instead of this natural division taking place, the French have acquired possession of a considerable part of the Jura on the Swiss side of the mountain ; while, on the other hand, the Alps, which divide Switzerland from Italy, belong almost wholly to Italy."

" And pray, mamma," said Edward, " is the size of a river according to its length ? I think it ought to be so ; for the more country it flows through, the more streams will join it and increase its size."

" That is not always the case," replied she ; " it depends a great deal on the nature of the country. A river may sometimes flow a long way without being joined by any other stream ; whilst at other places it may during an equal distance be joined by so many streams as to double or triple its quantity of water ; but in general the largest rivers are also the longest."

" There cannot be any very large river in England," observed Sophy, " because, being an island, it cannot have far to go before it reaches the sea."

" Considering the small extent of the island," replied her mother, " the rivers in England run over more ground than you would suppose. This is owing to the inequality of the land, which obliges the rivers to be continually changing their

course, and to wind about to avoid the rising ground."

"I wonder at that," said Caroline, "because there are no high mountains in England."

"It does not require a mountain," said Edward, "to make running water change its direction; it can no more rise over a mole-hill than over a mountain."

"It is true," said Mrs. B., "that the slightest rising ground is sufficient to turn aside a river; and it frequently happens that a river winds more in a plain, not quite level, than it does in a valley enclosed by high mountains.

"When a river issues from a valley into the open country, it continues seeking the lowest ground: it is therefore bounded on each side by higher grounds; but as the plain is wide and large instead of being long and narrow, its form is that of a basin rather than a valley, and the course of the river through the basin will point out its lowest part. Now, as all the neighboring streams, which take their rise in the surrounding high grounds, will flow towards the lowest part, they will consequently fall into the principal river. These smaller streams are called in French *versans*, which, literally translated, means *pourers*; or perhaps we should more properly call them feeders, as these streams feed the chief river."

"O! but I like the name of *pourers* better," cried Caroline, whose imagination led her to think of a wash-hand-basin; "they all pour water into the basin: but then," added she, after reflecting

a little, "the water in the basin would make a lake instead of a river."

"You must not carry the comparison of a wash-hand-basin too far," said her mother. "I did not speak of a basin of standing water, but of one of land, through which, a principal river, joined by neighboring streams, flowed. And for this purpose, one part of the basin must be lower than the other, to enable the river to flow on to the sea. When you are better acquainted with geography than you are at present, you will be able to trace on the map, not only the form of the basins through which the principal rivers flow, but to point out the tributary streams, and to ascertain the comparative elevation of the different parts of the basin."

"I think I could do that now," said Sophy; "for the highest parts of the basin must be where the smaller streams take their rise; and the lowest part where they fall into the principal river."

CONVERSATION EIGHTH.

WHY TOWNS ARE USUALLY BUILT ON RIVERS.—LAND AND WATER CARRIAGE, STEAM-BOATS.—ROWING-BOATS.—RATE OF WAGES.—TOWNS FORMERLY BUILT ON HILLS—ROME ; BOSTON, OR TREMOUNT.

THE next day the children were busy, studying the rivers on the map of Europe.

"What a great number of towns there are by the side of the rivers in this map, mamma," observed Sophy ; "I can hardly find a single town that has not a line running through it, representing a river. I wonder people should be so fond of living close by a river ; I think it much pleasanter to live on a hill, where you have pure air and a fine prospect."

"But cannot you guess any reason why the neighborhood of a river should be preferred ?"

"Perhaps, that people may catch fish in it for their dinner," said Caroline.

"Or, perhaps," observed William, "for the pleasure of bathing and swimming in summer, and sliding and skating in winter."

"There are much more important reasons than those to induce men to build towns on rivers," said their mother. "A great number of things are wanted in a town which are obliged to be brought *not only* from the surrounding country,

but from very distant parts ; it is therefore desirable to have a manner of conveying them which is easy and cheap, and the carriage of goods by water costs much less than it does by land. Stone and timber for building, and coals for burning, are such bulky materials, and so heavy, that it would be very difficult and expensive to bring them in wagons. The ships and barges, that convey them on rivers, will not only hold a great deal more than a wagon, but, requiring no horses to draw them, will cost much less."

"True," said Sophy ; "when things are brought in a wagon, you must not only pay for the wagon, but for the horses that draw it."

"And not only for the horses," observed her mother, "but for the corn and hay which the horses feed on. Now, the wind serves for horses to vessels, either at sea or on rivers."

"The wind serves for horses!" cried Cary, quite puzzled, "how is that?"

"Why," said William, "does not the wind make the ship go on? only it pushes it, instead of pulling, as horses do. That is, it pushes the sails, which are fastened to the masts, and the sails cannot move without the ship moving along with them."

"Well, I wonder I never thought of that," said Cary: "what a nice cheap horse the wind is ; for you need not buy it as you do a horse, it comes all of its own accord for nothing ! and besides it don't eat and drink like horses, nor want *a stable to live in*, nor a groom to clean it ; and

then it is so strong sometimes, that it will do more work than a great number of horses."

"Yes; but," said Edward, "sometimes the wind is a very restiff horse, for it will go the way it likes, and all the whips in the world, or all the spurs either, would not make it change its course."

"That is very true," said his mother; "but though we cannot change the direction of the wind, we may set the sails in such a manner that a wind blowing sidewise on the vessel will drive it up or down the river just as well as one that blows exactly behind the vessel. It is only when the wind is directly against the vessel that it cannot get on, and must remain at rest till the wind changes."

"But that must be very inconvenient, mamma, if the things are wanted in a hurry," said Sophy.

"So it is," replied her mother; "but there are many expedients to remedy this inconvenience. If the vessel is a barge [flat-bottomed boat] going down a river, the current, which you know always flows downwards, carries the barge along with it."

"But then," said Sophy, "if the barge happens to be going up the river the current will stop it, or make it go back again."

"O! mamma," said Caroline, "I know what is done then. Don't you remember the towing-path which we once saw alongside of a river, where a horse tied to a long rope pulled the barge?"

"So then, you see, you are obliged to have a horse after all;" said Edward.

"But only one horse," replied Cary, "to draw a barge through the water,—a barge which will hold as many goods as would require perhaps a dozen wagons and fifty horses to draw them on the road."

"But then how very slow it moves."

"That does not signify," said his mother, "for things which are not wanted in a hurry; and when haste is necessary, there is a better contrivance."

"I guess what you mean, mamma," cried Edward, "a steam-boat. O! a steam-boat is the cleverest contrivance of all, for then one need not care which way the wind blows: that is the way to manage the restiff horse."

"Or, rather, to do without it," observed his mother; "for steam does not change the wind, but enables the vessel to go against it."

"Besides, a steam-boat does not cost any more than a ship sailing," said William, "for it neither eats nor drinks."

"If it does not eat," said his mother, "it consumes a great deal."

"Consumes!" repeated William, "how can it consume without eating or drinking? O!" continued he, recollecting himself, "I know what you mean; it consumes a great deal of water to make the steam. But then, water costs nothing, so that would not add to the expense."

"And how do you turn water into steam, William?"

"O! now I understand it: the steam-boat consumes fuel to make a fire, to boil the water and turn it into steam; and as a great deal of steam must be made to push on the vessel, a great deal of water must be boiled, and a great deal of wood or coal must be burnt, and that must cost a great deal of money."

"Why, William," said Sophy, laughing, "I thought, with all your 'great deals,' following one another, that you were going to tell us the story of 'This is the house that Jack built.'"

"And there is one more 'great deal' that you have not reckoned," said Mrs. B.; "the steam-engine itself, in which the water is boiled, and which moves the boat, is a very expensive machine."

"Yes, but that is once for all," observed William; "not like the fuel, which is burnt every day."

"True," said his mother; "the steam-engine, being of metal, and very strong, will last many years, but not forever; it will wear out at last.

"However, though a steam-vessel appears to be a more expensive mode of conveyance than a sailing vessel, it saves a great deal of time by going so quickly, and is so clever in mastering the wind, that steam vessels are getting more and more into use every day. Then, when the wind is favorable, a *sail* is sometimes put up, and the

wind helps to move the vessel, and less steam is required, and less fuel consumed.

"So, then, between sailing-boats, and towing-boats, and steam-boats, there can be no difficulty in carrying things to the town," said Sophy, "provided there is a river. But, mamma, there is one sort of boat that you have forgotten, and that is a rowing-boat. You know John Baxter, who has such a nice garden by the river-side, carries all his fruit and vegetables to market in his rowing-boat; while poor Thomas Harper, whose garden is not near the river, is obliged to carry his things in a cart. I have often heard him say how he wishes he could bring them by water, and then he need not be at the expense of keeping a horse and cart."

"And what a number of people go to market on foot in the country," said Caroline, "carrying their eggs, and butter, and chickens, in baskets."

"When they live so near the market-town," replied her mother, "as to be able to walk there, any other conveyance is unnecessary. But to many large towns, as New York, for instance, a great part of the vegetables to supply the market are brought in boats; whilst to others, like Philadelphia, they are brought partly in boats, and partly from the surrounding country, in wagons; and to others still, they are transported by the latter conveyance only.

"There is no doubt," continued she, "but *that water carriage*, of whatever kind, is cheaper

than land carriage ; but a rowing-boat is the most expensive of all kinds of water carriage, because the men who row must be paid wages, which costs more than feeding horses. Do you remember when we made a little excursion in the harbor, we had four men to row us, and we had to pay each of them for his labor."

"But then John Baxter rows the boat himself, mamma, so he has nobody to pay."

"And if John Baxter was not rowing his boat he would be doing something else, would he not ?"

"O yes ! he is all day long working in his garden when he is not rowing ; and when he is, he is obliged to hire a man to work in his garden, or else he says it would be all spoiled."

"Well, then, if he pays a man to work in his garden, it comes to the same as if he paid him to row his boat."

"Yet I wonder," said William, "that the labor of men should cost more than that of horses ; for, besides feeding and taking care of the horses, you must buy them."

"Men are hired for wages," replied his mother, "and as they work for you or not, as they choose, they will not do it unless the wages you offer them be sufficient to buy them food and clothing, both for themselves and for their children who are too young to work, and also to pay the rent of their cottage or lodging, with many other things they want. And all that costs more than buying and feeding horses."

"Then the labor of men is the dearest of all," said Caroline; "next, that of horses; then boats of every kind, but sailing-boats and steam-boats are the cheapest of all!"

"Yes," replied her mother; "and water carriage being so much cheaper than land carriage, accounts for so many towns being built on rivers; and if you could observe the prodigious number of vessels there are sailing up and down our rivers to carry goods to and fro, some from the most distant parts of the world, you would be convinced of the advantage of locating towns near the water."

"A very great number of years ago, when people were barbarous and cruel, and had not good laws to protect their persons or their property, they thought more of their safety than of any thing else. They then used to build their towns on the summits of hills, because they could there the most easily fortify and defend them against an enemy. There are still a number of these towns perched on the pinnacle of a hill, in Italy; but now that men are become more civilized, and that the laws defend them better than walls and fortifications, they find it extremely inconvenient to live at such a height. In Sicily the inhabitants of towns perched on the tops of hills pay dear for their safety, for they are obliged to carry up every thing they want, even fire-wood and water."

"But, mamma," said Caroline, "they must have a beautiful prospect, and the air must be very pure."

"*True, but* people seldom enjoy the beauty

of a prospect while they feel the toil of carrying every thing they want up so great a height."

"And they can have no water carriage to help them," said Sophy, laughing, "for no river flows up-hill."

"I remember," said William, "that the Roman history says that Rome was built on seven hills; but they could not have been large ones, since there were seven in one town. Then you know the River Tiber runs through Rome, so that it had the advantage of water carriage."

"And Boston, I have heard," continued William, "was called, by the first settlers, Tremount, on account of its three hills."

"Three hills!" exclaimed Caroline, "I should like to know where they are?"

"Why," replied William, "there is Copp's Hill, nearly opposite Charlestown, from which spot the British (then our enemies, but now our fast friends) made their attack upon Bunker's Hill, in the Revolutionary War, 1775; next there is Fort Hill, in the east part of Boston, which is now a promenade-ground, but received its name, as I have read, from a fort being built on it; (upwards of two hundred years ago;) and the third hill is——"

"I thought you would have hard work to make out your story," said Caroline. "Now I remember, the third hill was dug down, long before we were born; it was called Beacon Hill. Mother can tell us about it," added William.

"Yes, I have been upon it oftentimes in my

childhood. It was situated just back of the State-House, and was called Beacon Hill, because there was fixed upon it a barrel of tar, the firing of which was to serve as a beacon, to alarm the people round about, in case of the approach of an enemy. It was a fine spot for health and exercise, and was a place of much resort by the inhabitants and strangers. From its top there was a fine prospect of the harbor and bay, and a charming view of the surrounding country."

"What a pity that it has been dug down," said Caroline.

"It is indeed a great pity," added William, "and I suppose that the Bostonians, who have reason to pride themselves on their delightful Common, and upon the scene presented from the cupola of their State-House, which, with one exception, is said to be the finest of the kind in the world, would be willing to pay almost any sum, if the hill could be put back again."

"One would think so," observed Mrs. B., "and yet, within two or three years past, I am told that another beautiful eminence has been levelled for the purpose of making house-lots. It is greatly to be regretted, that in active, thriving cities and towns, comfort, convenience, and all that contributes to the health of the people, and the ornament of the places, too often fall sacrifices to a spirit of speculation, and desire for the accumulation of wealth.

"I am glad to see that a different spirit has *prevailed* among the projectors of many towns at

the west, which has induced them, whilst looking out for their private interest, not to lose sight of the public weal.

"But we are widely wandering from the subject of our conversation. I would observe, however, that the three hills mentioned by William have generally been supposed to be the ones which gave to the present Boston the name Tremount; but we are informed that this is a mistake; that they were three little rising hills on the top of a high mountain, at the northwest side of the town; from which it appears, that these three eminences constituted a part of one hill, or 'mountain,' as an early historian called it, of which Beacon Hill was the highest peak or summit, and which stretched along from Hanover-street, (which is not far from the Tremont House, where we stopped when in that city,) over to the water, near Cambridge Bridge, the Mill-dam, and the foot of the Common, where an elegant public garden has been recently laid out. William's reference to Rome and her seven hills, reminds me of an observation of a late antiquary, who wrote an interesting 'Description of Boston,' which abounds in much curious matter. 'The descendants of the first settlers,' he writes, 'regarded these hills with a kind of religious veneration, and Boston is not less distinguished for her three hills, than Rome for her seven.' But, alas! we must add, that this, her glory, has long since departed.

"To conclude our present conversation, I would remark, the towns that are situated to the greatest

advantage are those on a navigable river, that is to say, one that is deep and wide enough for large vessels to sail on, for then the inhabitants can not only get what they want from their own country by water carriage down the river, but the large vessels from foreign countries will bring them goods up the river."

CONVERSATION NINTH.

A REAL SPRING VISITED, AND FOLLOWED TO ITS JUNCTION WITH A RIVER.—INTERMITTING SPRINGS.—AN ISLAND IN THE RIVER.—THE SEA.—ISLANDS IN THE SEA.—THE SUMMITS OF SUBMARINE MOUNTAINS.—SEA-WEEDS AND FISHES.—BATTLE BETWEEN A WHALE, A SHOAL OF HERRINGS, AND A FLOCK OF SEA-GULLS.

In the afternoon, Mrs. B. gave her children a great treat; she took them to see a real spring, which gushed out of the ground, about half a mile from the house.

"How prettily it bubbles up," said Sophy, "just as if it was glad to come out of that dark hole into the open air, and see daylight."

"But I do not understand this spring," said William, thoughtfully; "there is no mountain here, not even a hill; the ground is quite flat, and yet the water rises out of it, which I thought water could not do."

"This spring," said his mother, "comes from a pond, or reservoir of water, which is hidden inside the hill you see yonder, about half a mile distant. There was no opening, by which the water could get out on the side of the hill; so it went on, running down internally, till it reached this spot; and here it has made its way out: for

you see the hill in which the reservoir is concealed is considerably higher than the ground on which we stand; and you must know that when a spring comes from a reservoir which is in higher ground, the water springs upwards, almost as high as the reservoir from which it proceeds. But you must be content to take this for granted, for you are too young to understand the cause of it."

"I suppose," said Cary, "its springing up in this manner is the reason of its being called a spring."

"No doubt," replied her mother.

"And where does this pretty little brook that runs from the spring go to?" inquired Sophy.

"It runs into the river about a mile off. If you would like to see the rivulet fall into the river, I do not think it will be too far for us to walk."

"O no!" replied the children, all together; "we should like of all things to follow the dear little rivulet."

"If you did," replied Mrs. B., "you would not reach the river to-night, for the rivulet winds so much in its course, that I dare say it runs four or five miles before it reaches the river, whilst, if we walk thither in a straight line, the distance will scarcely be above a mile."

Edward had scrambled up a steep bank by the road-side, and called his brother and sisters to come up to him, as he could see the rivulet winding about for a long way.

"*But I see* nothing to make it wind about so,"

said Sophy, "for the ground is quite flat. I do think it does it to amuse itself, as we do when we are at play. You said, mamma, young rivulets love to be frisky ?"

"If it could see and feel," replied her mother, "I should not wonder at its amusing itself in wandering about such a pretty green meadow; but as it cannot, it simply follows the law of Nature in flowing downwards. If the ground were perfectly level, or flat, as you call it, the water would spread over it to the right and the left instead of flowing onwards; but where the stream flows the ground certainly descends, and if it descends winding instead of in a straight line, it is because some slight rising of the ground occurs, which, though imperceptible to our eyes, turns the river out of its straight-line course."

"Then would a river always flow in a straight line if the ground were quite even ?"

"Certainly; but as the ground is seldom perfectly even for any length of space, a river seldom runs in a straight line for any considerable distance."

The family then followed a path which took them straight to the river, but during the walk they seldom entirely lost sight of the rivulet. They saw it sometimes near at hand, at other times far distant; and twice they had the pleasure of seeing it joined by other little brooks, which considerably increased its size. As they went on, Edward observed a bed of sand and small pebbles, which looked as if a rivulet had once

flowed there, but was now dry. His mother said she supposed that to have been the case, and probably the rivulet had ceased flowing because there was not water enough in the reservoir to supply it. She told him that when the reservoir was not filled up to the opening whence the rivulet flowed, no water could come out, and the spring must cease to flow, and the bed of the rivulet remain dry, until fresh rains should have replenished the reservoir, and then it would flow again. Such springs, she observed, were called intermittent, because they intermit, or alternately flow and become dry.

They now came within sight of the river, and hastened to the spot, where they beheld their little rivulet plunge into it. Caroline could not help exclaiming, "O! poor dear little stream; it is quite cruel of the river to swallow it up."

"No," said Sophy, "I don't think so. The little brook seems to me as if it were running into its mother's arms; and you know, Cary, that it is not destroyed, but runs along with her, as you do by the side of mamma. But I suppose," continued she, "there is an end of the river too, before it reaches the sea; for it is but a little one, and it must run a great many miles before it gets there."

"Yes," said her mother; "it falls into a larger river about six miles distant; but if we walk a little further we shall see an island in the river."

"O dear!" exclaimed the children; "a real

island ?" and they ran eagerly forward, each trying to be the first to reach it.

It was a small island, planted with weeping willows, whose long slender branches hung down and trailed in the water. There was a pretty little rustic bridge, which led from the river's brink to the island ; and the children skipped over it, and placed themselves on a seat made of the rough branches of trees, while an old woman who lived in a cottage close by brought them some strawberries from her garden in a cabbage-leaf, which were very refreshing after their long walk.

" What a pity we did not make a bridge and a seat in our island," said Caroline.

" For whom ?" asked William, " unless you had Lilliputians or dwarfs to sit on it."

" O! we might have made some little dolls of a proper size. And is this island made in the same way that our stony island was ?"

" Yes," said her mother ; " it is a sort of hill which rises from the bottom of the river, and the top of which is above the water."

Edward inquired whether the islands in the sea came up from the bottom in the same manner ; and having heard that they did, he observed that they must be immense mountains to reach from the bottom to the top of the sea.

His mother told him that that part of the globe which was covered by the sea had also its mountains and its valleys, and that consequently the bottom of the sea was uneven like the dry land,— therefore, where the sea was shallow, the hills

need not be very high to rise above the surface of the water, so as to make islands; but that it was true, if the sea was deep, it would require the height of a mountain to reach to its surface.

"Many islands," she continued, "have been formed or raised above the surface of the water within the recollection of man. The former are the product of animals, of which we shall speak hereafter, and the latter are the result of volcanic action; such as the Azores, Canaries, and Lipari Islands, all of which are marked on the globe, as William will show you. Indeed, from the investigations that have been made by scientific men, there is good reason for supposing that most of the islands in the Atlantic Ocean, and very many in the Pacific and Indian Oceans, have been produced by the action of volcanoes. Not only have islands made their appearance within the memory of man, but some have disappeared; one instance that I now think of, occurred within a comparatively recent period; this was an island about a mile in circumference, situated near St. Michael's, one of the Azores, which made its appearance after the eruption of a submarine volcano, in June, 1811; three months afterwards it began to sink, and near the end of February, 1812, it was entirely gone, and nothing remained to mark the spot but an occasional rising of steam out of the sea."

"Steam! mother," exclaimed Caroline, "what could make steam? There couldn't be any fire *in the* water!"

View of a Volcanic Island in the Mediterranean, produced by a submarine eruption, in July, 1831, as mentioned on page 232.

"It is true, my child; but the submarine or under-sea volcano, that I alluded to, abounded with it, and its heat produced the same effect upon the water in the sea, that the fire on the hearth produces upon the water in the tea-kettle. But this subject I must defer to some future conversation."

"I suppose," said Edward, "there are under the sea ranges of mountains as there are on land, and that some are as high as the Alps, and others no higher than the Pyrenees, and others as small as the hills of New England. But would these last reach to the surface of the sea?"

"That depends upon whether the ground from which they rise is high or low, or, in other words, whether the sea is shallow or deep in those parts. Sailors at sea, when they drop a sounding-line into the sea, in order to discover its depth, sometimes find it very shallow, though they are far distant from any land. What do you suppose to be the cause of this?"

"I dare say it is some high mountain," said Edward, "not high enough to reach the top of the sea, so it makes an island underneath the water, and that makes the sea so shallow there."

"You cannot call it an island, below the surface of the water, for in your geography an island is said to be a piece of land surrounded by water, not covered with it."

"Then there can be no plants or animals on that ground under water?"

"O yes! *there is* abundance of marine or sea

plants, which we are apt to call weeds, because they are of no use to us."

"Like the sea-weeds we pick up on the sands," said Sophy, "which look so pretty when they are spread out."

"Ay, and the pods on the rocks," observed the two boys, "that crack so nicely under your feet when you walk upon them."

Their mother said that there was a great variety of plants growing at the bottom of the sea, though not so many as there were on dry land.

"But of what use can they be," said Caroline, "for nobody lives in the sea?"

"You forget the fish, Cary; there are, I should think, as many animals in the water as on land. Do you recollect the immense number of small shell-fish sticking to the rocks, some of which were not bigger than a pin's head?"

"Then what a prodigious quantity of fish there must be in the great Pacific and Atlantic Oceans!" said William.

As soon as he returned home he went to look at the globe, and, turning it round, he observed that there was much more water than land; and it was therefore very likely that there were more fish, of one kind or other, than there were animals on dry land.

"In the North Sea," said his mother, "thousands of herrings are often caught in one night; and that is a trifle to the number which escape, and remain swimming about and enjoying themselves. Now, these herrings, every year, pro-

duce a large quantity of spawn, or small eggs, each of which gives birth to a young herring."

"Then I wonder," observed Sophy, "that the sea is not all full of herrings, without reckoning the other fish."

"It is the other fish that prevent it," replied her mother; "the large fish devour the small ones, and thus room is made for the young ones that come from the spawn."

"But what is the use of so great a number of fish," inquired Sophy; "so many more than can be caught and eaten?"

"O, Sophy!" said her mother, "we must not think only of ourselves. God Almighty, it is true, has given us power over all the animals of the creation; but He did not create them merely for our use, but for their happiness and his own wise purposes. The fish enjoy themselves swimming about in the sea, and when they are swallowed up by some larger fish, they suffer scarcely a moment's pain; and they not only afford food for the fish that devour them, but make room for the young fish."

Edward looked thoughtful, and then said, "There certainly could not be room for all the fish, if they lived to be old; and besides, if they did not eat each other, there would be no food for them."

"Not for all of them," said Mrs. B., "but some fish feed on the vegetables the ocean produces, as some animals live on grass and herbs; but the fishes are so numerous, that, if the greater

part did not devour each other, many would die of famine."

"But there are some fish," said Edward, "that feed on insects, and rise to the surface to catch them as they fly above the water?"

"O, yes!" said Cary; "fish, I know, are extremely fond of flies; for it is by an artificial fly at the end of his fishing-rod that papa catches them. So, then, they not only devour each other under water, but leap up to catch the poor little insects that fly in the air."

"Yes," said her mother; "and if fish are so voracious, they have also many enemies; and, independently of destroying each other, are often devoured by animals that fly in the air."

"What, by insects, mamma? surely there are no insects big enough to eat a fish?"

"No, but there are birds," replied her mother. "There are a great many water-fowl, or aquatic birds, and even animals, like the beaver, which dive under water and remain there some time; there are others which dart down on fishes which they see rise to the surface, and devour them. I once heard a naval officer describe a curious battle between a whale, a shoal of herrings, and a flock of sea-gulls. The whale, perceiving the herrings at some distance, swam towards them to feast upon them, and the poor herrings, which could neither outswim nor defend themselves from so gigantic an enemy, crowded together for safety. A number of sea-gulls were at the same time hovering over the spot, in hopes of sharing the ban-

quet. As soon as the whale came up with the herrings, it dashed among them with such force as to throw a great number of them up in the air: these were pounced upon by the birds, and carried off; while the whale made an abundant repast in the waters, between the mouthfuls spouting up the water like a fountain."

CONVERSATION TENTH.

EARTH CARRIED DOWN TO THE SEA BY RIVERS.—RAPIDITY OF CURRENTS.—FRESHETS.—EMBANKMENT OF RIVERS FLOWING FROM THE APPENINES.—MOUNTAINS UPHELD BY GRASS.—A SOD OF GRASS EXAMINED.—EARTH SUPPORTED BY ROOTS OF TREES.—BRANCHES OF FOREST AND OF FRUIT TREES.—LANDSLIPS.

"MAMMA," said William, "what is the character of the land near the mouths of rivers, such as the Danube, for instance?"

"It is low and flat."

"I should have thought," resumed William, "that such large rivers, when they come rolling on into the sea, would have overflowed and washed away such tracts of land."

"On the contrary, it is the rivers that produce them."

"Then," said Sophy, laughing, "one might fancy that rivers carried down land, instead of water, into the sea."

"They carry down both," said her mother; "all rivers wash away more or less earth from the land they pass over. If the soil is of a stiff, compact nature, like clay, the rivers can wash away but little; but if it is of a loose nature, like sand and gravel, which easily crumble, the river carries *down a great* deal into the sea.

"The effect of the action of the sea upon the land, may be observed at various spots on the New-England coast, such as Cape Cod, and many islands in that vicinity."

"What a queer name for land," said Caroline.

"Yet a very appropriate and significant one. Were more attention paid to this subject, we should escape one source of frequent error and confusion. The Indians, or Aborigines of this Country, as they are called, were remarkable in this respect, and their practice is well worthy of our imitation. Their names were generally, if not always, expressive of something peculiar to the places; such as the form, the kind of fish, bird, beast, &c. found there; the character of the land, the nature of the water, &c. &c. In like manner, Cape Cod was so named by Captain Gosnold, in 1602, on account of the abundance of cod-fish that inhabited the water thereabouts."

"I dare say, mamma, that the rivers that rise in the Appenines, which you said crumbled down like my mountain, must carry a great deal of earth into the sea."

"They do, indeed," replied her mother; "so much so, that those rivers are often very muddy."

"But why does not the mud sink to the bottom of the river, instead of being carried all the way to the sea; for, when I amuse myself with throwing mud or dirt of any kind into the pond, it falls directly to the bottom?"

"You must consider, my dear, that a pond is still water, and has not a current, like a river, to

carry away the mud as it flows along. Now, in the rainy season of the year, and at all times after great storms, the rivulets are fuller of water, flow down the mountains with more force, and wash away more sand, gravel, or earth of whatever kind they chance to meet with. I have seen the river Arno, which rises in the Appenines, and runs through Florence, transformed, by a few hours' rain, from a clear placid stream into a rapid muddy torrent, rolling its turbid waters along with such impetuosity, that no boat durst venture on its surface; and the Romans called their river the yellow Tiber, from the quantity of yellow earth borne along by the stream."

"And is this mud carried as far as the sea?" inquired Sophy.

"The distance to which a river will carry solid materials depends upon the rapidity of the stream and the nature of the solid materials, some being much lighter than others, and therefore more easily borne along by the current. If the water flows only three inches in a second of time, it will carry clay; if six inches, it will carry sand; if twelve inches, gravel; and if the current flows three feet in a second, it becomes a torrent which will carry every thing along with it. The Arno has, at different times, all these degrees of velocity; after violent rains, it will at first bear away whatever it meets with; but when the rain ceases, and the rivulets are less full, the river slackens its pace, and the greater portion of the solid materials subsides to the bottom. The currents of some rivers,

such as the Amazon and Orinoco, are so rapid as to bear them along some distance into the sea, without mingling with it, so that fresh water may be obtained out at sea. The Amazon does not lose its freshness until it gets upwards of two hundred miles from the coast. We are told that Columbus procured fresh water, carried along in the ocean by the Orinoco, some time before he obtained sight of land."

"William, can you tell me what the overflowing of a river is called?"

"A flood."

"Yes, a flood or freshet. Sometimes it does a great deal of damage. The river Ganges, in 1822, destroyed a vast amount of property, and, what was still more deplorable, drowned from fifty to a hundred thousand human beings."

"What a dreadful thing these floods must be!" exclaimed Cary.

"Yet," replied her mother, "they are often necessary and highly useful, as in the case of the Nile; but of this I will speak at some other opportunity."

"Are all rivers subject to floods, mamma?" inquired William.

"The only large river, not subject to them, that I think of, is the River St. Lawrence, which you will find on the map of the United States, as it makes a part of the northern boundary between us and Canada. However wet the season, its waters are not sensibly increased; however dry it may be, they are not perceptibly diminished. Its

level is sometimes disturbed, to be sure, but this is owing to the action of powerful winds upon it."

"Where do these floods occur the most frequently?" asked William.

"In that part of the world called, from its great heat, the torrid or burning zone, the limits of which are mentioned in your geography and marked on your atlas. During, and immediately after, the rainy season, these floods occur. There is generally great regularity about the period of their recurrence. There are some rivers, however, such as our Mississippi, that overflow their banks very irregularly. In order to guard against the damage which would otherwise be thus occasioned, embankments, or, as they are termed at the south, *levees*, have been thrown up, for two or three hundred miles, on either side of this river."

"I have sometimes seen in the newspapers," said William, "a notice of a certain occurrence having happened on the *levee* at New Orleans, but I never before clearly understood what was meant, or what sort of a place it might be."

"But, mother, does the river often rise so high as to render such embankments necessary?"

"Yes," my child, "it is not uncommon for it to rise upwards of thirty feet above its ordinary level. Some of its branches, the Ohio, for example, sometimes rise nearly double that height, and the Orinoco has been known to rise four times as high, inundating the country over a space a hundred miles in width."

"*The earth* which is washed down from moun-

tains, and sinks to the bottom of rivers, must always remain there; I wonder, therefore, that it does not at last fill up the river, so as to make it overflow," said William.

"The rivers that rise in the Appenines would certainly do so," replied Mrs. B., "if the people of the country were not very careful to raise embankments on each side to prevent their overflowing."

"Yet," said Sophy, "as every year more mud sinks to the bottom of the river, the embankments will require raising continually."

"That is very true," replied her mother; "and the banks on the margin of the Arno are already so high, that in some parts you may drive along the road on the side of the river without seeing it; the same is the case with the Adige, and the Po, and the Rhine, all of which are only prevented from overflowing the country, by the artificial barriers that have been erected. These are called *dikes*."

"What an unpleasant state of things," said Caroline.

"Certainly; and also dangerous: for the embankments cannot continue to be raised many years, in proportion to the increase of mud at the bottom; so that it is difficult to say how the neighboring country will escape being one day or other overflowed. These embankments are not only raised on the margins of the above-mentioned streams, but more or less on all the rivers that take their rise in the crumbling Appenines.

"The bed of the Po has been so much raised by earthy deposits, that its water flows along at a level higher than the tops of the houses in Ferrara, situated near by."

"What a pity," said William, "that something could not be contrived to prevent these mountains from crumbling down and doing so much mischief."

"Unfortunately," replied his mother, "the soil of the Appenines is not of a nature that grass will grow on; for a good thick turf would prevent the mountain from crumbling away."

"Why, mamma!" exclaimed Caroline, "you do not mean to say that little tiny blades of grass can hold up a mountain?"

"It is only the surface, or outside of the mountain, that wants support," replied her mother; "if that is upheld and prevented from crumbling down, the inside of the mountain will be quite safe. But it is not the blades, but the roots of the grass which support the soil. Each root grows in tufts of small fibres or threads, which spread out and intermingle with the adjoining tufts, so that they become as it were interwoven together, something like netting or matting, so closely that the earth cannot make its way through them; and when the rain pours down on the mountains it trickles between the blades of grass, without carrying away any of the soil."

"How very curious!" said Edward; "so, then, the mountain is really upheld by a sort of netting *or matting of* roots. Well, I never could have

imagined such a contrivance. I should have thought a strong wall would have been wanted, at least."

"O, no!" said Cary, "do not talk of such things as walls; the green grass is much better, with all its pretty daisies and cowslips, and the sheep and cows feeding on it."

"There is nothing," observed Mrs. B., "more admirable in the works of the creation, than the easy and simple means which are used to produce so many things which make us happy; and I hope you will never think of this without feeling thankful, and striving to deserve the goodness of God."

Mrs. B. then took her children out into the pleasure-grounds, where the gardener happened just then to be laying down some sods of grass. She turned up one of them to show the children the roots of the grass, but they were so matted into the earth of the sod that they could not well be distinguished. She then desired William and Edward, who, to acquire knowledge, did not mind soiling their fingers a little, to pick out the earth, in order that the roots might be more clearly seen. They set to work eagerly; and William observed that it was no wonder the rain could not wash down the earth in mountains covered with grass; for that he had great difficulty to pick it out with his fingers, so closely the roots held it imprisoned. At last he thought of a picker in his pocket-knife; and with this he contrived to free the roots so well from the earth, that the children could easily see how thickly the fibres were matted together.

Edward asked whether the roots of trees would not be stronger, and better calculated to support mountains, than the roots of grass. "And you would have no objection to trees, I dare say, Cary," said he, turning towards her.

"O, no!" replied she; "and if they have fruit growing on them I should like them still better."

"But fruit-trees are not pretty trees," said William; "I have often observed what thick stumpy branches apple and pear trees have."

"If they had long slender branches, like forest-trees," observed Mrs. B., "which wave so gracefully in the wind, they would not be able to support the apples and pears which hang upon them."

"That is very true, mamma," said Sophy; "for even as it is, the branches of apple-trees are often obliged to be supported with poles stuck in the ground, to prevent the weight of the fruit from breaking them."

"But have not beautiful trees, with waving branches, any fruit to support, mamma?" inquired Caroline.

"Yes; all trees bear fruit of some kind or other; either pulpy, like apples and pears; or a berry, like raspberries and mulberries; or nuts, like walnuts and chestnuts; or seeds, enclosed in a shell or capsule, like elms and peas. It is from the fruit that the seed is obtained, and without seed, no plant could propagate itself. But though all trees bear fruit, we usually call those fruit-trees, that bear fruit which is good to eat; and if this *fruit is heavy*, the branches must be stiff and strong

enough to support them, though the tree may not be so beautiful.

"But I have not yet answered Edward's question, about the roots of trees. They are certainly much stronger than those of grass; but yet they are not so well calculated to support the soil, because they are not intwined together like those of grass. They are better fitted to prevent great masses of earth from slipping down the side of a mountain, or a steep hill; and trees and shrubs are often planted on banks and steep slopes for this purpose. When such an accident happens it is called a landslip, because a large piece of land or ground slips down the declivity."

"I recollect," said Sophy, "once seeing a large piece of a hill which had slipped down to the bottom, with all the trees growing upon it; you cannot think how funny it looked, for the trees grew out sidewise, instead of upright, their roots still sticking in the ground that had slipped. But what is it makes the earth slip down, mamma?"

"Probably its being undermined by some spring of water; and when on a steep slope, the earth easily slips, if it is loosened. Such accidents sometimes happen in mountainous countries, which are attended with very serious consequences. A dreadful one occurred some years ago, at Goldau, in Switzerland; but it is too late to tell you the story to-day, so we will reserve it for our next conversation."

CONVERSATION ELEVENTH.

GOLDAU.—STORY OF MARIE BURIED ALIVE.—LANDSLIP AT THE WHITE MOUNTAINS.—AVALANCHES OF SNOW.—GLACIERS AVALANCHES.—ASCENT OF MONT BLANC.

THE children were next morning very impatient to hear an account of the accident that occurred at Goldau in Switzerland; and their mother told them that some years ago a spring of water undermined a mountain so as to loosen a great part of it; but being very precipitous, instead of gradually slipping down, it fell headlong into the valley below, burying the village of Goldau, which was situated at the foot of the mountain, beneath its broken masses.

"I recollect," said she, "reading an account of a poor little girl named Marie, who was overwhelmed by the ruins of her father's cottage. The earth and rocks had fallen upon it in such a manner as completely to cover it, but without entirely crushing it to pieces; so that the poor child, though buried alive, was not only unhurt, but had some little space to move about in. She at first gave herself up for lost, expecting nothing less than to die of hunger, and she sat down and wept bitterly; she then said her prayers, and felt more *comfortable.* After a few hours she heard the

sound of the bleating of a goat, and she knew that it was one of her father's goats which she had been accustomed to milk, and which, like herself, had been buried alive, but without having received any injury. 'Poor Dodo,' cried she, 'I am sure you want to be milked, and how glad I should be to drink your milk, I, who have neither food nor drink; but indeed I know not how to reach you in this darkness.' The sound of bleating came from above; and after a great many trials, she at length contrived to climb up to the spot where the goat was, and rejoiced at being able to get a good draught of milk; nor was the goat less pleased at being relieved of its burden. She felt much comforted by this meal, and cheered herself with the hope that the poor goat would give her nourishment enough to keep her from starving till she might perhaps be dug out. The next day the bleating of the goat was very faint, and scarcely any milk could be drawn from it. She knew the poor animal could not give her milk unless it was supplied with food; and it seemed to her impossible to obtain any nourishment for it. However, instead of giving way to her disappointment, she resolved to exert herself to try whether she could find any means of getting at some hay. She thought it very probable that the place in which the goat was confined was the stables, which in the upset of the house might have been thrown over the room in which she was; and if so, she knew that there was plenty of hay in the rack above the manger, but it was too high for the goat to reach. After

many efforts to get at the hay herself, and pull it down to the goat, she was obliged to give that up; but she at length contrived so to place herself, that the goat, by resting its hinder legs upon her shoulders, could reach the hay. You may imagine her delight when she first heard the goat drawing it from the rack, and beginning to eat; for she knew that she had thus provided not only food for the goat, but a regular supply of milk for herself so long as the hay lasted. After living thus for several days, she heard a knocking, and guessed that it was made by people digging in search of her. She called out to them as loud as she could, but received no answer, for the place was too much closed up for them to hear her voice. This grieved her much, for she feared that they might give over the search before they had reached the spot in which she was; shortly after, she heard a quantity of stones and earth fall near her, and concluding that an opening was made, she was rushing forward to the spot where she had heard the noise, when it suddenly occurred to her that she might be crushed by the falling rubbish, and she prudently retreated instead of advancing. But she again halloed out, and was so happy as to be answered by the voice of her father; and in a short time she was in his arms, and carried to her mother, who was overjoyed to find her still alive."

The children, who had listened with deep attention to this anecdote, were quite delighted to find that poor Marie had escaped, and William *inquired what it* was that occasioned the fall of the

mountain, since there were reservoirs of water in all mountains, which did not make them fall.

"Not commonly," replied Mrs. B.; "but they may occasionally be so situated as to produce that effect. Suppose the upper part of the mountain to consist of sandstone, which is remarkably porous, so that a great quantity of rain would sink into the mountain."

"We know how easily water passes through sand," said Edward; "but if sand sticks so close together as to become stone, it can have no pores?"

"I beg your pardon," replied his mother; "the sand, mixed up with other materials, is converted into a solid substance called sandstone, but the pores or interstices, though rendered smaller by the grains of sand adhering together, still exist, and are large enough to admit of the passage of water.

"Well, let us suppose the inferior strata, or lower part of the mountain, to be made of clay; you know what will happen then?"

"O! yes! the water will work a hollow or cavity in the clay, and form an internal pond, and from this reservoir a spring will flow."

"Stop," said his mother; "suppose there should be no opening through which the water of the reservoir could flow?"

"O! then, I do not know what would happen," said Edward; "let me see—" added he, reflecting; "the water must accumulate in the reservoir, and when it is full, it must press against the earth all round it; and as the sandstone above

it is lighter than the clay, it will perhaps loosen it and make it fall."

"Very well made out," said his mother; "and this is probably the cause which produced the fall of the mountain of Goldau."

"Then I wonder such accidents do not happen often," said Sophy.

"It very seldom happens," said Mrs. B., "that water cannot make its way out quietly. The catastrophe of Goldau is one of the very few I have heard of that has been attended with such disastrous consequences; but the fall of large masses of snow from the mountains is very common.

"Before speaking of these, however, I will give you an account of another landslip, one that occurred within a few years past, and at a spot much nearer home than that of which I have just spoken."

"What! mother, in our own country do you mean?" inquired Caroline.

"Yes; in the White Mountains of New Hampshire, where William and Edward have often expressed a desire to go, in order to witness the grand scene laid open to the view of the beholder, standing upon its heights. And I dare say that you and Sophy would admire to accompany them."

"Not," replied they, "if we are in danger of being buried up as little Marie was."

"Such an accident is possible, though not probable. You should remember, however, my children, that it is not upon the mountain-top, or in

the valley, that we are alone beset with dangers; for they surround us in all places, and under all circumstances, and a knowledge of this should induce us so to behave as to be always ready to leave the world, whenever and in whatever way our heavenly Father may see fit to call us hence.

"The account of the disaster to which I allude, is thus described by a recent writer:

"'The Notch* of the White Mountains will long be remembered for the tragical fate of a whole family, who were swept away by a landslip or slide of earth from the side of the mountain, on the night of the 28th of August, 1826. This family, by the name of Willey, occupied what was called the Notch House, in a very narrow interval between the bases of the two mountains. No knowledge of any accident from the mountain in former times existed to create any apprehension of danger in their situation. Their dwelling stood alone, many miles from the residence of any human being, and there was an aspect of rural neatness, simplicity, and content in their manners and life, that strongly interested the traveller whom chance or curiosity led into their neighborhood. For two seasons previous, the mountains had been very dry, and on the 28th of June, there was a slide not far from the house, which so alarmed them, that they erected a temporary encampment

* The Notch is a narrow pass that stretches along for two miles between high cliffs, and seems to have resulted from a violent tearing asunder of these cliffs.

a short distance from their dwelling, as a place of refuge.

"'On the morning of August 28th, it began raining very hard, with a strong and tempestuous wind. The storm continued through that day and night, but it appears the family retired to rest without the least apprehension of any disaster. Among them, were five beautiful children, from two to twelve years of age. At midnight, the clouds which had gathered about the mountain seemed to burst instantaneously, and pour their contents down in one tremendous flood of rain. The soil, which had been previously soaked through, was suddenly loosened by the flood, and the trees, pushed and wrung by fierce winds, acted as levers in breaking up the earth. The landslip began upon the mountain-top, immediately above the house, and moved down the mountain in a direct line toward it, in a sweeping torrent, which seemed like a river pouring from the clouds, full of trees, earth, and rocks. On reaching the house it divided in a singular manner within six feet of it, and passed on either side, sweeping away the stable and horses, and completely surrounding the dwelling. The night was dark and frightfully tempestuous. The family, it appears, sprang from their beds and fled naked into the open air, where they were instantly carried away by the torrent and overwhelmed. The slide took every thing with it, forest, earth, and stones, down to the solid rock of the mountain.

"'*In the* morning, a most frightful scene of

View of the Alps, near Vernstein.

desolation was exhibited. All the bridges over the streams were gone. The road was torn away to the depth of fifteen or twenty feet, or covered with immense heaps of earth, rocks, and trees.

"'In the Notch, and along the deep defile below it, for a mile and a half, the steep sides of the mountain had slidden down into this narrow passage, and formed a complete mass of fragments. The barn was crushed, and under its ruins were two dead horses, but the house was uninjured. The beds appeared to have been just quitted; their coverings were turned down, and the clothes of the several members of the family lay upon the chairs and floor. The little green in front of the house was undisturbed, and a flock of sheep remained there in quiet, though the torrent, forming a curve on both sides, had swept completely round them, and united below, covering the meadows and orchard with ruins. The bodies of seven of the family were dug out of the drift-wood and mountain ruins, on the banks of the Saco.'

"In travelling in the Alps, I have seen many large masses of snow precipitated,—they are called *avalanches*. They occur generally in summer, when the snow begins to melt. The sound is like distant thunder, which is considerably prolonged by the echo of the surrounding mountains."

"And is it not dangerous for travellers, mamma?" inquired Caroline; "I am sure I should be terribly frightened, if I heard one."

"No, not if you saw that it was falling at such

a distance, or in such a direction, that there was no chance of its reaching you ; and the path of travellers is contrived so as to avoid these avalanches, as much as possible. They however sometimes fall where they are little expected, and the roads in the Alps are often stopped up by them for a short time. I recollect once meeting with a mass of snow on the road through the Alps, but it was so small, and, having lately fallen, so light, that the post-boys thought they could drive through it ; when suddenly we heard the yelping of a dog, and found that a poor pointer, that was slung in a basket underneath our carriage, was literally buried in this mass of snow ; however, he was much sooner extricated than poor Marie, and continued his journey on foot after this accident ; for he had such a terror of being shut up in the basket, that it was a long time before we could reconcile him to it."

" And are there never avalanches of ice ?" inquired Caroline ; " they would be much more dangerous ; ice is so much harder than snow."

" Very frequently," said Mrs. B., " but they seldom come in the way of travellers. There are immense accumulations of ice in the higher regions of the Alps, called Glaciers ; they are situated generally in the narrow valleys which separate the highest mountains, and are frozen in large irregular masses. There is a celebrated one near Chamouni, much visited by travellers ; it is called the *Mer de glace*, or *Sea of ice*, from *its great resem*blance to the sea in a storm, were

it suddenly frozen, excepting that there are crevasses* between the waves of a depth that has never been fathomed. Glaciers being generally on a declivity, when any of these waves, or rather, I should say, these rocks of ice, get loose, they come rolling down with great violence, and, meeting with others in their passage, they knock them down, and all go tumbling together headlong to the bottom. There cannot be a more magnificent spectacle than to see several of these avalanches come thundering along, while the sound is re-echoed by all the mountains round."

"How I should like to see it and to hear it," said Sophy, "if I were not afraid."

"There is little or no danger," replied Mrs. B.; "the guides of Chamouni, who accompany travellers to the Mer de glace, are very intelligent, and have learned, by experience, how to avoid danger. It was from Chamouni that M. de Saussure many years ago ascended Mont Blanc. He was the second person who ventured on this perilous expedition; and when you are older, you may read an account he has written of it. The first ascent was made by Dr. Pacard, in 1786; Saussure ascended the following year."

"But surely he did not go up alone?" said Caroline.

"O no! he had eighteen guides with him;" and Mrs. B. showed them a print in M. de Saussure's book, in which their ascent was represented. "They were all tied to the same rope, so that

* Crevices or clefts.

if one of them fell into a crevasse, those before and behind him could pull him out; and with this precaution, they, after much labor and fatigue, reached the summit, where they remained five hours. While there the pulse was found to beat more rapidly; and they complained of exhaustion, thirst, and want of appetite. The sky appeared of a very deep blue color approaching black, and the stars were visible in the shade. Fourteen ascents had been made, up to 1828; one of these was by two gentlemen from New York."

"Could they not see the crevasses?" said Sophy.

"They are frequently covered with snow; and besides, the brightness of the sun, reflected by such masses of ice, was so intense as almost to blind them."

"They should have worn green veils," said Sophy.

"They did so," replied her mother; "but, in spite of this precaution, I believe no one has ever ascended Mont Blanc without having his eyes affected."

"Why is it called Mont Blanc?" asked William.

"It receives its name, Mont Blanc, or white mountain, from the immense mantle of snow with which its summit and sides are covered, and which is estimated to extend 12,000 feet without the least appearance of rock to interrupt its glaring whiteness. From its summit there is a view *150 miles in* extent in nearly every direction."

"What a pity that the bright light hurts the eyes so! for there must be such a beautiful view from the top," observed Caroline.

"Rather magnificent than beautiful," replied her mother, "a collection of snowy mountains, interspersed with rugged peaks of rocks, without any vegetation, for the more beautiful part of the country is too distant to be distinctly seen."

CONVERSATION TWELFTH.

DELTAS—IN THE SEA, IN LAKES.—DELTA OF THE NILE.—OVERFLOWING OF THE NILE.—DELTA OF THE DANUBE—OF THE GANGES.—COLORS OF RIVERS.—TENDENCY OF FLOWING WATERS TO REDUCE THE GLOBE TO A LEVEL.

THE next day, Mrs. B. observed that they must return to the rivers they had been talking of, and see what becomes of the mud which is carried by them as far as the sea. "The sea," said she, "which has no current, in some measure stops the current of the river, and forces it to slacken its course. A curious phenomenon is sometimes presented by this meeting of the waters. As the ocean tide sets in, the water, coming violently in contact with that of the river, occasions a high wave, which, rolling upwards, oversets boats, inundates the shores, and at times does much damage."

"I understand this," said William, "for the waves of the sea always beat against the shore, so they must rise up against the river when they meet; there must be a sort of battle between the river and the sea; the river flowing onward to pour its waters into the sea, and the sea dashing its waves against it, as if to stop it."

"Very true," said his mother; "there is a *beautiful description* of such a battle in Pignotti's

fable of the River and the Drop of Water. Well, during this struggle between the two combatants the greater part of the mud escapes, and falls to the bottom at the entrance of the river into the sea ; and, in the course of time, it accumulates, and forms the low flat tracts of land which you observed on the map, and which are to be found at the mouths of most of the large rivers. They are called *Deltas.*"

"O dear !" exclaimed Caroline ; "I wonder whether our little river has made a Delta in the pond, which we called the sea ; for you know, mamma, it carried away a great deal of sand and earth from my mountain, which you said was so like the Appenines."

"Perhaps," returned Mrs. B., "you may find some remains of sediment, but on too small a scale to be very conspicuous."

"And are there not Deltas formed by a river when it falls into a lake, as well as when it falls into the sea ?" asked Sophy.

"Yes ; but they are smaller. Here," continued Mrs. B., pointing to the map of Europe, "is a small Delta made by the River Rhone, at its entrance into the Lake of Geneva ; but the Delta which the Rhone forms at its entrance into the sea is much more considerable. Some of the largest Deltas existing are those of the Danube, the Ganges, and the Nile. The Nile, which flows from Nubia into Egypt, is a very remarkable river. It overflows its banks after the rainy season every year ; and the mud which it deposits

on the land, when the waters retire, is of so rich a nature that the country requires no other manure."

"Then, mamma," said Edward, "why do not the people who live on the banks of the Arno and the Po, and all those rivers that come loaded with mud from the Appenines, allow them to overflow, for the mud would manure their land when the water ran off?"

"The earth that is washed down from the Appenines is not a rich mud like that of the Nile, but of a sandy nature, which does not make good manure."

"Yes," said William, "as grass cannot be made to grow upon the Appenines to support the soil, the soil cannot be good for vegetation."

"Besides," resumed his mother, "if these rivers were suffered to overflow, the towns and villages in their neighborhood would be inundated."

"And how do they prevent that in Egypt," said Edward, "when the Nile overflows, for there must be towns there, and villages?"

"Both the period of the year, and the height to which the Nile will rise, when it overflows the country, are known with great exactness. The Egyptians, therefore, take care to be prepared for it; and they build their houses on spots which are above the level of the inundations of the Nile. There they are safe, and wait with patience for many weeks, until the water subsides, and the Nile *finally* returns to its usual bed. They then go to

their fields and plantations, sow their seed, and in due time reap abundant crops from this fruitful soil."

"But, mamma," said Sophy, "how can this river make a Delta, when it falls into the sea, if it deposits all its mud on the land?"

"Notwithstanding the quantity of mud left on the land, the river carries with it as far as the sea a sufficient quantity to form the immense Delta which may be seen at its mouth."

"I wonder," said William, "that such great Deltas do not in the course of time choke up the rivers, and prevent their finding their way to the sea."

"A river always washes its way through its Delta, though sometimes with difficulty; and is often separated by it into several channels. Thus you see the Nile, which flows through Egypt in one body of water, is divided by the Delta into three branches, which fall separately into the Mediterranean Sea. The Danube is split by its Delta into no less than seven channels, with as many mouths, which pour their waters into the Black Sea.

"The Ganges in India, which brings down earth from the Himmaleh Mountains, the highest in the world, has formed a Delta at its entrance into the Indian Sea, more than twice as large as that of the Nile; it projects above two hundred miles into the sea, and is about the size of the whole of Wales. It is covered with jungle or low wood, and forms a sort of wilderness infested by tigers, hyenas, crocodiles, and alligators, which

last two, being amphibious, frequently leave the streams into which the Ganges is separated, to bask in the sun on its banks, and are often dangerous for travellers. Then, besides the risk of being devoured by these noxious animals, the ground itself is in a perilous state ; for, during the rainy season, the river rushes down with such impetuosity that the Delta is in a great measure inundated, and the river, which is divided into a number of channels, often forms new beds, leaving the old ones dry."

Sophy asked, "Whether the water of the Black Sea, into which the Danube falls, was of a darker color than other seas ?"

Her mother said, "No ; that if water had any color it was a blue tint like the sky, but so slight that it could be seen only where there was a considerable body of water. The River Rhone appears of a bright blue color; but if you fill a glass, or even a bucket, from it, the water is quite colorless. But large bodies of water, such as rivers and lakes, often appear colored, from reflecting the objects around them. I have seen the Lake of Geneva assume a beautiful crimson tint, from reflecting the sky at sunset.

"Some lakes, on the other hand, are so clear, that you can look to the very bottom, and can easily see the fish as they rapidly move to and fro ; this is the case with Lake George, in the State of New York, whose waters are as pure, and transparent, and colorless, as the beautiful crystals *that are* found upon its islands. On account of its

purity, it was called, by the Indians, Horicon, or Lake of the Silver Waters."

"And our river," said Sophy, "looks quite green, sometimes, from reflecting the trees which grow on its banks."

"Then rivers," continued Mrs. B., "are often really tinted with color by the solid substances which are melted in and mixed up with the water. The Arve, which flows from the glaciers of the Alps, and falls into the Rhone a little beyond Geneva, is of a muddy white, owing to the sand which it washes away from the rocks of the Alps; and it forms a very curious contrast with the Rhone, at their junction, the blue and the white stream running together, side by side, for a considerable distance, before they completely unite.

"Several of the rivers in the Tyrol, flowing over rocks of dark slate, wash away particles of that substance, and so impregnate the waters with it that they appear almost black. And in the neighborhood of Grindelwald, in Switzerland, there is a stream called 'Black Water,' which flows over slates, and is nearly as dark as ink.

"The Red River, in Louisiana, owes its color to the red ochre, a species of earth, which it washes away."

"O, yes!" said Sophy, "I know what ochres are, I have so many of them in my painting-box. But I did not know they were earths; I thought they were only paints."

"But paints must be made of something, my dear; ochres are made from earths; gamboge,

madder, lakes, and many others, are made from vegetables; and Prussian blue and carmine are derived from the animal kingdom."

"And when," said Sophy, "I take too much paint in my brush, and dip it into the glass of water, the whole of the water is colored with the paint."

"Is the Red Sea so called," inquired William, "from the color of its water?"

"No," observed Edward, "I remember that this part of the Indian Ocean is said to have been called by the Greeks the Erythrean Sea, as some suppose after a King Erythras; and as the Greek word *eruthraios* also means *red*, the Latins derived from it their appellation, *Mare rubrum*, whence the English name *Red* Sea, and not from the color of its water."

"Very well explained," observed Mrs. B. "I am happy to find that you treasure up information from reading and conversation, and do not, as many thoughtless children do, run over a book or listen to what is said, for mere amusement or from an idle curiosity, and at the conclusion exhibit as utter ignorance of the subject as they did at the commencement.—There are several rivers besides those already mentioned, which derive their names from their color. I may mention, for example, the Yellowstone, one of the largest branches of the Missouri River, so called from its yellowish-brown color."

"And, mamma," cried Caroline, "don't you *remember the* yellow rivers in the Highlands of

Scotland, you read about, which look as if they were made of small beer or porter, instead of water; and whose cascades, with the white froth, appear exactly like sparkling ale?"

"These rivers flow from peat mosses, and it is the yellow earth, or ochre, suspended or mixed with them, which gives them that color."

"I wonder," said William, "that the Rhone and the Arve should be of such different colors, since they both rise in the Alps."

"The Rhone is generally turbid, like the Arve, in its course from the Alps along the Valais, before it enters the Lake of Geneva. In passing through that lake its current is considerably slackened by the large body of water which it traverses, and the mud which it had brought along with it subsides to the bottom; so that when the river issues from the lake, at Geneva, its waters are pure and transparent, and appear remarkably blue."

"So, then, the Rhone washes itself clean in the lake," said Sophy; "it is a good large basin, with water enough in it to wash any river clean."

"Besides," said Caroline, laughing at Sophy's joke, and willing to have one of her own, "you know that the Rhone leaves a good deal of mud and dirt on the border of the lake before it plunges into it." Then, fearful she should not be understood, she added, "I mean the Delta."

"I think," said Edward, with a more serious look, "that as water is constantly washing down earth, and mud, and pebbles, and all sorts of

things into the valleys and rivers, and lakes and seas, the earth must become more and more flat; for the mountains must be lowered, and the valleys be filled up."

"This effect of water," replied his mother, "is in a great measure counterbalanced by other circumstances; but which we cannot enter upon yet."

CONVERSATION THIRTEENTH.

WHY THE SEA DOES NOT OVERFLOW.—MEDITERRANEAN.—VAPOR RISING FROM THE SEA INVISIBLE.—EVAPORATION GENERAL TO LIQUIDS.—DRYING LINEN.—LAKES AND SEAS.

"MAMMA," said Sophy, "since all the rivers run into the sea, how full it must be! I wonder it does not overflow."

"O! I dare say," said Edward, with the exultation of one who has made a discovery, "I dare say, that it is the quantity of water the rivers pour into the sea which makes the tide rise up on the shore, as you know it does every day all along upon the coast."

"But then," said his mother, with a smile, "what is it that makes the tide ebb, or go back again? for you know that it is low water, as well as high water, every day."

"That I do," said Edward; "and I do not know which I like best; for at high water we amuse ourselves with throwing stones into the waves; and, at low water, we make ponds in the sands, and crush the sea-weed on the rocks under our feet. But I cannot tell what it is that makes low water, for the rivers pour into the sea all day long, and all night too; so that the sea must grow fuller and fuller, and the tide ought to be rising higher and higher, till it overflows the land."

"That would indeed be the case," replied his mother, "if the rivers produced the tides; but they do not."

"O! then, pray tell us what does make the tides."

"No, I cannot," replied his mother; "because it would be too difficult for you to understand; you must wait till you are older."

The children looked disappointed—but after a little pause, Edward said, "But cannot you tell us, mamma, why the sea, receiving so many rivers, does not overflow?"

"I shall try; but first, you must observe there are a great many seas. Look," continued she, showing them a large globe, "here is the great Pacific Ocean, and the Atlantic Ocean, and the German Ocean, and the North Sea, and the Mediterranean Sea, and a large number of others."

"Yes, but there are a great many more rivers than seas," said Edward; "let us only count the number of rivers that run into the Mediterranean Sea; and it is not a very large one either: there is the Rhone, the Arno, the Ebro, the Tiber, the Adige, and the Po, and many others."

"It is very true," said his mother; "but you must know that water is constantly rising out of the sea, as well as falling into it."

"Indeed!" cried the children, with surprise; "we never saw any water rise out of the sea."

"Have you never observed steam rising out of *a pot of water* that is boiling?" asked their mother.

"O, yes!" replied Sophy; "a great deal of steam comes out of the tea-kettle when the water is boiling fast, and but very little when it is only warm."

"And still less," said her mother, "when the water is cold."

"O! none at all when the water is cold," said Caroline; "at least I never saw any."

"That is true, my dear, but there is some that you cannot see; for the drops of water of which it is made are so very, very small, that they are invisible."

The children never doubted the truth of any thing their mother told them, but as they could not understand this, they looked both surprised and puzzled.

"I can convince you that invisible steam does arise from cold water," continued Mrs. B.; "though I cannot show you what is invisible. Pour a small quantity of cold water into this plate, and then place it in the garden, and in a few hours the plate will be empty."

"O, yes!" said William; "the water will be dried up."

"And what is being dried up, William?"

"Indeed I don't know; I never thought what it was; but I suppose the water goes away into the air, as it does from wet linen that is hung up to dry."

"Just so," said his mother; "the water is changed into invisible vapor, and evaporates, or, as you call it, goes away into the air."

The idea was new to the children, and they seemed a little perplexed. Caroline said, "She thought it had been the wind that dried wet linen, for that when she washed her doll's clothes, and hung them out in the garden where there was a wind, they dried much faster than in-doors."

William said, "That wind was nothing else than air moving about; so the more wind there was the more air there would be to dry the doll's clothes."

"There is not more air in windy than in calm weather," said Mrs. B.; "it only moves quicker, and, constantly changing as it passes over the linen, dries the clothes quicker.

"The air," continued she, "removes the water by dissolving it, something like melting sugar or salt in water."

"Sugar and salt are solid things," said William, "and therefore can be melted; but water, being a liquid, is melted already."

"True," replied his mother; "water cannot be melted, but it may be so dissolved in the air that you can neither see it, nor feel it."

Cary asked, "Whether the sun did not help to dry wet linen, for she knew that the washerwoman liked to hang the wet linen out in the sun that it might dry quicker."

Her mother said that was true.

"The other day I was in a great hurry to get my writing dry," said Edward, "to be able to turn over the page; for I was to go and fly my *kite as soon as* I had finished. So I went and

held it out of doors: the sun shone on one side and the wind blew on the other, and I was doubting whether I should turn it towards the sun or the wind, for I did not know which would dry it quickest."

"That depends on the degree of force with which the wind blows, and the degree of heat with which the sun shines. But," continued she, "the sun helps the air to dry linen, because it warms the water in the linen; and you know the warmer water is the more it steams or evaporates."

"Then," said Edward, "the sea must evaporate more when the sun shines than when it does not."

"Then it must evaporate more in the day than at night," said Sophy.

"And more in summer than in winter," observed Caroline.

"And more in the torrid zone, where it is so hot," said William, "than it does here. If I had been in the torrid zone, I dare say I should have turned my writing to the sun rather than to the wind. But the sun is never hot enough any where to make water boil; is it, mamma?"

"O, no! certainly, not on our globe," replied his mother.

"And yet," continued William, "I have heard that the sun was hotter than any fire or furnace in the whole world."

"That may be true; but then you must recollect its great distance from us. When you want

to make a kettle of water boil, you place it upon the fire so that it touches the burning coals ; if you placed it a few yards distant from the fire and expected it to boil, you would be disappointed."

"O! but we should not be silly enough to expect it to boil at such a distance from the fire," said Caroline.

"Well," continued her mother, "the sun is millions of miles distant from us, so it would be silly to expect it to make water boil here."

"I only wonder that it should feel so hot as it does," said Sophy.

"And do rivers, and lakes, and ponds evaporate, as well as the sea ?"

"Yes," replied her mother ; "all water evaporates, even Sophy's dirty puddles ; and not only all water, but all liquids : but the evaporation from so large a body of water as the sea, is much more considerable than from the water on the land."

"O, mamma!" said William, "I know some water that cannot evaporate."

"What is it ?" inquired his mother.

"The reservoirs of water that are inside the hills and the mountains : they cannot evaporate, for there is no room for the steam to rise ; and then there is neither sun nor air under ground."

"Very true," replied she ; "it is only when exposed to the air that liquids evaporate ; and think how wisely this has been arranged by Providence ; for, if the reservoirs of water under *ground were* liable to evaporate, the springs would

most of them be dried up, and we should be in want of water."

"And pray, mamma," said Sophy, "what becomes of all this invisible steam?"

"This invisible steam," replied Mrs. B., "is called vapor; some portion of it remains dissolved in the air, but the greater part rises up high in the atmosphere, and there it makes clouds; and you know what becomes of clouds."

"O! then we can see it again when it rains," said Cary; who had apprehended that the invisible vapor disappeared for ever.

"Now," continued her mother, "you see that the constant evaporation of the sea, both night and day, must take a great deal of water out of it; as much, perhaps, as there is falling into it by the rivers."

"True," said William; "and so the one will make up for the other, and the sea remain constantly of the same fulness."

The children at first seemed satisfied with this explanation; but, after a little reflection, it occurred to Edward that the clouds, when they pour down in rain, fall into the sea, as well as on land; "therefore," said he, "the sea receives water, not only from the rivers which run into it, but from the rain which pours down upon it; so I think, one day or other, it must overflow."

"It is very true," replied his mother, "that the sea receives water, not only from rivers, but from the clouds, in the form of hail, rain, or snow, all these being made of water; but the evapora-

tion from the sea is so great that it makes up for all this. There are several large lakes, or small seas, (whichever you choose to call them,) such as the Dead Sea and the Caspian Sea, which, like the ocean, have a number of rivers constantly pouring water into them, without any outlet; it is evaporation alone which carries off the water, and prevents their overflowing."

"Then, indeed, mamma," said Edward, "I think they ought to be called seas, not lakes; for lakes, you know, have one river at least that runs through them, like the Rhone in the Lake of Geneva, which pours water in at one end, and carries it away at the other."

All the children agreed in this opinion; and William observed, that if the Caspian Sea and the Dead Sea were called lakes, the sea should be called a lake too!

The children all laughed at this idea; but their mother told them that some people called it so, and said the sea was the largest lake in the world. "But, for my part," continued she, "I think it better to confine the term lake to those which have rivers flowing both in and out of them, and call the others seas; but it signifies little by what name things are called, provided you well understand what they really are.

"In regard to the Mediterranean," continued she, "there can be no doubt that it should be called a sea, for, as you have already observed, it receives the waters of many rivers, without any *flowing from it*; on the contrary, there is a regular

current flowing into it at the Straits of Gibraltar."

"Indeed!" cried Edward, with astonishment; "what can the Mediterranean do with so much water?"

"This current has puzzled wiser heads than yours, Edward; and many philosophers have wondered, as you say, what the Mediterranean could do with so much water; some of them have conjectured that there might possibly be an under-current flowing out, and carrying away water from the Mediterranean into the Atlantic, but it has not been ascertained that this is the case; and I believe the general opinion is, that the evaporation carries off more water than the sea receives from the rivers which flow into it, and that accounts for the current setting in from the Atlantic through the Straits of Gibraltar."

CONVERSATION FOURTEENTH.

CURRENTS OF WIND.—ACCOUNT OF A HURRICANE.

"PRAY, mamma," said Sophy, "what is it that moves the air, so as to make a wind? I remember, when I was a very little girl, I thought it was the trees blowing about that made the wind; but I am not so silly as to think so now."

"It would indeed be silly now," replied her mother; "because you are old enough to have observed that the wind blows as hard on a plain where there are no trees, as in a great park, where there are many. But some years ago you were too young to take notice of that. You were then very fond of playing with my fan, and I recollect showing you how moving the fan made a wind; it was therefore very natural that you should fancy that the boughs of the trees were like large fans, and produced the wind by moving; while it is just the reverse, for it is the wind which moves the branches of trees."

"But, mamma," said Cary, "I have often fanned myself with the branch of a tree, and it makes a wind like a fan."

"O!" cried William, "don't you know, Cary, that any thing whatever that pushes against the air, and moves it, makes a little wind just in *that spot?* I have sometimes fanned myself with

my battledoor, when I was too hot, from playing at battledoor and shuttlecock; and sometimes with my pinafore, when I had nothing else."

"Then," said Caroline, "if one branch of a tree can move the air a little, all the branches of all the trees must move the air a great deal, and make a great deal of wind."

"But who is to move them?" said Willy, laughing; "would you have boys climb all the trees, to shake all the branches?"

"To be sure I never thought of that," replied Cary; "they cannot move unless the wind moves them. But, then, tell us what it is makes the wind, mamma?"

"I fear," said Mrs. B., "that, though you are no longer a very little girl, you must wait till you are older before you can fully understand what it is that puts the air in motion, so as to produce wind. I can only tell you that the most common cause of wind is a change of temperature; that is, a change either from hot to cold, or from cold to hot; but you must wait a few years longer before you can understand how such changes move the air, and produce wind. You may, however, easily conceive, that, when once the air is put in motion, it moves so easily, that a wind which begins in Maine may pass over all the States south of it, and, if it blows hard, continue all the way to the equator."

"And, if the wind is exceedingly strong," said William, "it will perhaps go beyond the equator, down to the south pole."

"No," replied his mother; "it will stop in the torrid zone, for there it will meet another wind coming from the south pole. The poles, you know, are the coldest regions on the globe, and the equator the hottest; and this is the reason that the wind generally blows from the north and south poles to the equator."

"And pray what becomes of these two winds when they meet at the equator? Do they cross each other, and go to the opposite poles, or do they quarrel and fight, and so blow up a storm, when they meet?"

"Sometimes they quarrel," said Mrs. B.; "but they always finish by making friends, and go hand in hand together round the world, from east to west, making a regular northeast wind to the north of the equator, and a southeast wind to the south of the equator, all the year round."

"It must be very funny," said Sophy, "for the wind always to blow the same way, though I think I should be tired of it at last. But how very convenient it must be for ships that are sailing to the west; they are sure to have the wind blowing the right way."

"It is so advantageous to merchant vessels that carry goods to trade with foreign countries, that this wind has been called the *trade-wind*. It was first discovered by Columbus, when he sailed across the Atlantic Ocean in expectation of finding a new passage to the East Indies. In his way he met with storms, which greatly discour*aged the sai*lors, who were anxious he should give

up the attempt, not knowing what dangers might befall them. The wind had for some time been north, so that they were driven southward."

"O!" cried Willy, "that was the wind going from the north pole to meet the wind from the south pole, at the equator."

"Well," continued his mother, "when they reached the torrid zone, to the astonishment of Columbus and all his crew, they found the wind regularly blowing westward."

"That was after the north and south winds had met at the equator," said William; "and lucky it was for them; it was just the way they wanted to go, to discover America. How much pleased they must have been!"

"Columbus was," replied his mother; "but the sailors, who were great cowards, fancied that they would be driven by this wind, they knew not whither, and would never be able to sail against it when they wanted to return to their homes."

"Indeed, I think they had some reason to be afraid," said Caroline.

"No," replied Mrs. B.; "I have already told you that it is not necessary that the wind should blow exactly the way a vessel wants to sail. The sails may be spread in such a manner that the ship will go north or south when the wind blows east or west; it is only right against the wind that the vessel cannot sail. The little fleet of Columbus would, therefore, have always been able to sail northward, till they got out of the

trade-wind, which reaches only to about fifteen degrees on each side of the equator."

"But, mamma," said William, "if the wind is constantly blowing from the poles to the equator, all the air will be blown to the equator at last, and we shall have none here."

"So much the better," said Caroline; "I don't like windy weather."

"Ah! but we should not be able to fly the kite," said Edward.

"Or, what is still worse," observed Mrs. B., "we should have no air to breathe; for wind, you must recollect, is nothing but air in motion; but, fortunately, the air finds its way back again from the equator to the poles, and keeps blowing backwards and forwards between the two, so that it is constantly passing over our heads, and we are in no danger of wanting air either to breathe or to fly kites."

"How can it get back again to the poles?" said Caroline; "does it go through caverns under ground?"

"O, no! there would be little room for it under ground, and there is plenty of space above. Air that is heated swells out and becomes lighter, and therefore rises up. So, after being heated by the scorching rays of the sun at the equator, the air mounts up even higher than the clouds, and returns to the poles much above the cold current of air which comes from them."

"So, then," said Sophy, "the two winds go *backwards and* forwards, between the poles and

the equator, without interfering with each other; the cold wind below, and the hot one above."

"If all air swells out and rises when heated," said William, "the air in this room, where there is so large a fire, must do so, and, being lighter than the cold air out of doors, must rise up to the ceiling."

"So it does," replied his mother; "and fresh, colder, heavier air comes in beneath to take its place."

"But then what becomes of the air that rises to the ceiling, for it cannot get out there?"

"It makes its way out wherever it can find an opening," replied his mother; "by the doors and windows, if they are open, or up the chimney; if these are all closed, it escapes through the key-hole, and any crack it can meet with."

"And how does the colder air get in?"

"In the same manner that the hot air gets out, wherever it can find an entrance."

"Then the hot and the cold air must often meet, and, if the entrance is but small, have a struggle which shall get through it."

"Not often; for the warm air, being lightest, always keeps uppermost, and the cold air beneath, so they seldom interfere. I will show you how well they manage it." Mrs. B. then lighted a taper, and held it close to the opening of the room door, which stood ajar. She moved it slowly from the top to the bottom, and the children saw with surprise that, in the upper half of the opening of the door, the flame of the taper bent

outwards, being blown in that direction by the current of air that was making its way out of the room; while, in the lower half, the flame was bent inwards, showing that in that part, a current of air was coming into the room.

"Now, pray, mamma, hold the candle just in the middle," said Edward, "and let us see what the flame will do there."

"What do you suppose it will do?" said his mother.

"Why, if it is not pushed by either wind, it ought to burn quite straight upright," said Edward.

And upon trial they found that it did do so.

"What well-behaved currents these are," said Cary; "instead of quarrelling and disputing, they divide the opening between them, and then move through, the one inwards, the other outwards, without meddling with each other at all."

"And just in the same manner," said Mrs. B., "do the two currents to and from the poles move; the heated ones in the higher regions of the atmosphere, the cold ones nearer the earth."

"How admirably that is contrived," said Edward; "when any thing seems wrong and puzzling, one is sure, by proper examination, to find out that there is some way to get over the difficulty."

"No wonder that all is admirably contrived," replied Mrs. B., "when you think by whom this world was created, and all that surrounds it—*clouds, air,* sun, moon, and stars. It may, how-

ever, happen, that something in Nature may appear to be wrong, without your being able to account for it; and in that case you should say to yourself, 'The fault lies in my ignorance, not in the laws of Nature; if I understood them better, I should see that all was right.'"

"That I am sure I should," replied Edward. "But pray, mamma, tell me, since the wind is always blowing towards the equator,—I mean," added he, "the cold current which we feel next the earth,—why have not we constantly a north wind?

"If the globe were covered all over with water," replied Mrs. B., "we probably should; but the land produces great variations of heat and cold, and is continually changing the course of the wind.

"You know that when Columbus got out into the Atlantic Ocean, at a great distance from any land, he found that the wind blew regularly from the north for some time before he got into the trade-wind."

"And how fast does the wind blow, mamma?"

"It varies extremely," replied she. "You know the proverb says, 'as changeable as the wind,' and it varies as much in velocity as in direction. In common times it moves from one to ten or twelve miles an hour; but in a hurricane it has been known to go as much as eighty or ninety miles."

"O! what a frightful wind that must be!" said Caroline.

"Such violent winds occur but seldom, excepting in the West Indies, and other parts of the torrid zone; as I told you, it sometimes happens, that before the north and south winds unite, and blow together in a friendly manner round the world, they have a scuffle when they first meet, and then they produce tempests, whirlwinds, and hurricanes, which are often very dreadful."

William was at this moment attentively watching the clouds. "Look, mamma," said he, "at those white fleecy clouds very high up in the sky that are moving one way, while the dark clouds lower down are moving just the other way. Those clouds must be moved by two winds blowing in different directions, and I dare say one is the wind coming from the pole to the equator, and the other the wind going back again."

"You are mistaken, my dear; the upper current of air which returns to the poles is so high as to be above our observation. The two currents you now perceive by the different course of the clouds are owing to some accidental change of heat and cold, which, as I told you, often happens, and disturbs the regular course of the wind."

"I wish," said Sophy, "that these two winds were of the same height, and met each other. What a puffing and blowing we should have then! My hat, perhaps, might be blown off one way by one of the winds, and my shawl the other way by another."

"You would not wish it if you were in the *torrid zone*," said Edward, "and the opposite

winds were to produce a hurricane, for then you might be blown away yourself, as well as your hat and your shawl."

"O, do, pray, mamma, tell us about a hurricane!" cried all the children.

"I will try to recollect an account of one," said their mother, "which was related to me by a naval officer who was on board his ship at the time, in the West Indies. 'The day,' said he, 'had been extremely hot, and the air perfectly still. A thick mist collected in one spot on the horizon, which in the evening, as it grew darker, looked like a black wall. A low moaning sound was heard in the air, first in one place, then in another; at length the dark mist came sweeping along the waters towards us; as it approached, the moaning sound became louder and louder, till it increased to a roaring noise which stunned us. The sea, though still calm, was covered with a white foam; when suddenly the wind burst upon us with so violent a gust that the sailors could not hear my voice, even through a speaking-trumpet, so that it was impossible in this extremity to give any orders but by signals; but even signals were soon useless, for the sea all at once rose mountains high; the vessel was driven before the wind, and dashed upon some rocks on the coast, where in a few minutes she went to pieces. Above half the crew perished. I was among the number who were so fortunate as to escape, but we were torn and mangled in a dreadful manner by the sea dashing against the rocks on which we were cast.

Still we clung to them, as our only chance of escape, till the hurricane had in some measure subsided ; we then contrived to scramble to the shore, where we looked around for succor, but the scene before us only increased our distress. Cattle lying dead in the fields ; trees torn up by the roots ; negro huts dashed to pieces, and the wretched negroes who survived howling over those who had perished ! When we reached the town the scene of desolation appeared still more dreadful. Above half the houses had been thrown down, and numbers of the inhabitants lay buried beneath the ruins. In some places they were digging out those whose cries showed that they were still living ; in others, they were carrying away the bodies of the dead. No one noticed us, bleeding and suffering as we were ; and indeed the situation of those buried beneath the ruins was so much more pitiable that we thought more of giving, than of receiving relief. We joined a party of men who furnished us with pick-axes, and set to work with what strength we had left. I was directed by some low groans which issued from beneath a mass of rubbish, and as I continued making my way with the pick-axe I heard the screams of children frightened by the noise it made. At length I had the consolation to extricate a negro mother and three young children from beneath the rubbish. One of them, who had a leg broken, I carried in my arms ; and the others, who were only bruised, contrived to crawl, *along with* their mother, to a house, where they

received assistance, and all did well.' The captain of the vessel then sought for some one to dress his wounds, and it was a long time before he completely recovered."

The children were deeply interested by this account, but not one of them wished to go to the West Indies to witness a hurricane, and wondered how any body could live in such situations.

CONVERSATION FIFTEENTH.

CAUSE OF THE SALTNESS OF THE SEA.—SALT LAKES AND SPRINGS.—THE DEAD SEA.—EVAPORATION OF A GLASS OF SALT WATER BY HEAT.—BUOYANCY OF SALT AND FRESH WATER.

"MAMMA," said William, "what is the reason that the sea is salt, while the rivers which run into it are not?"

"I suppose," said Edward, "that there are salt-mines at the bottom of the sea, such as there often are on land, and that the sea-water continually washing over them melts the salt, and so becomes salted."

"There may probably be salt-mines here and there under the sea," said Mrs. B.; "but that would not be sufficient to salt so large a body of water. Only think how much it would require to salt the Atlantic and Pacific Oceans."

"Yes, indeed," said Sophy; "for if I put nearly half a salt-spoon full of salt into my plate of soup, it does not taste half so salt as the sea; so it must take mountains of salt to salt the whole sea; but where does it get it all from, mamma?"

"What would you say if I told you that it was the fresh-water rivers which made the sea salt?"

"I should say that you were joking, for that *seems to* me impossible," replied Sophy. "I

was wondering that the fresh-water rivers, pouring into the sea night and day, did not destroy its saltness."

"I am not joking," said her mother; "but though I will not positively say that it is the rivers which make the sea salt, I can assure you that most of those who have studied the subject are of that opinion. It is true it requires some explanation."

The children opened their ears wide, and listened with great attention, expecting to hear something very difficult; when their mother rang for a salt-cellar, and the servant having brought her one full of salt, without saying another word, she took it to a pump in the garden. There was a large tub about half full of water standing under the spout of the pump, and Mrs. B. desired the boys to pump it full. This was no easy matter, the tub was so large; and when the boys were tired, their sisters, and even mamma, pumped in turn. When at length it was filled, Mrs. B. put a spoonful of salt into the tub, and then made the children taste the water, and they declared they could not taste the salt at all, but that was no wonder, for they did not expect a spoonful of salt to salt so large a tub full of water.

"I think," said Edward, "this tub is almost as big as your bathing-tub, mamma; and I remember they used to put as much as fourteen pounds of salt into it, to make it as salt as sea-water."

"Well, you must know," said their mother,

"that the water of rivers, though it tastes so fresh, contains more or less salt, but not enough to be perceptible to the taste."

"Just like the tub of water," said Caroline.

"If that is the case," observed William, "each of the rivers must pour a little salt into the sea."

"But such a little," said Sophy, "that I do not think they could ever salt it."

"You do not consider," continued her brother, "that they pour a little salt into the sea every day and every night, and every hour of the day and night, and every minute of the hour, so that in the course of time there would be enough to make the sea salt."

"It is thus," said Mrs. B., "that the saltness of the sea is generally accounted for.

"By some, however, it is supposed that the sea was endowed with its saline properties at the creation, and that all the salt met with upon the land was derived from the sea. But if the sea had parted and continues to part with the immense amount of salt that occurs in such abundance in various quarters of the world, it seems reasonable to suppose that it would be constantly becoming more fresh."

"Besides, mother," observed Edward, "if this were one of the original properties of the sea, I should think it ought to be equally salt in all parts of it."

"We should very naturally suppose so," *replied Mrs.* B., "as, from the continual agitation

of its waters, whatever is contained therein would probably be diffused uniformly through the whole body. Yet we know that there is not a uniform saltness throughout; the waters in the polar regions contain comparatively but a small quantity of salt, while the reverse holds true in the tropical regions. Dr. Daubeny ascertained by experiments, that there is a greater quantity of salt in the water at a distance from the continents of America and Europe, than near the coast; and, in one instance, the water drawn up from a great depth contained a larger proportion of salt than that at the surface. But this is a subject not devoid of difficulty, in whatever point of view it is examined.

"The average amount of common salt in the ocean is estimated at two and a half per cent., so that if the average depth of the water be, as is calculated, ten miles, were the water entirely evaporated, the thickness of the saline mass would be more than one thousand feet; and were this spread uniformly over all of that portion of the globe occupied by land, it would form a bed of rock-salt upwards of half a mile in thickness."

A servant just then came with a message to Mrs. B., who returned to the house, telling her children she would be back again in a few minutes. In the mean time, the children continued their conversation.

"When once the salt gets into the sea," said Sophy, "it cannot get out again, for there are no

rivers which run from the sea into the land to carry it back."

"No," said William; "all the rivers run into the sea; but I was just thinking that there is another way the salt may get out of the sea. Don't you remember what mamma told us about the vapor that rises from the sea? now a great deal of salt must be carried up with this vapor into the clouds."

"But then," observed Sophy, "the clouds would be salt, and the rain that falls from them would be salt too."

"O!" cried Edward, "who ever heard of salt rain, or ever tasted salt rain!"

"Perhaps the rain may be salt out at sea," said William; "because it is made of vapor which evaporates from salt water; while the rain is not salt on land, because it is fresh water that evaporates there. I wish mamma would come back, that we might ask her."

As soon as Mrs. B. returned, the question was put, and she said, that the vapor from the sea consisted of water as free from salt and as pure as that which rose from the fresh water on land; that salt, or whatever else was dissolved in the sea, subsided, that is, remained at the bottom, while the vapor rose in the air. "I will pour some of the salt from the salt-cellar," continued she, "into this glass of fresh water, till it becomes as salt as sea-water." She did so, the children stirring it carefully all the while, in order to melt it.

"What a quantity it takes," said Caroline, "to make only a glassful of sea-water! I do not think there would be salt enough in all the house to make the great tub as salt as sea-water."

"Very likely not," said her mother. "Now," continued she, "if you evaporate the water in this glass, all the salt which I put into it, and which is now melted, will remain at the bottom of the glass."

"Then we shall see it again," said Caroline, quite pleased at the idea, "and we may put it back into the salt-cellar."

"No, it will not be fit for that purpose, for it will not be in separate grains, as it was before it was melted; they will all adhere together in one mass."

"But it will take a long time to evaporate the water, mamma, for the sun does not shine to-day."

"We can hasten the evaporation by an artificial sun," said her mother.

"An artificial sun!" exclaimed the children; "how can you make an artificial sun?" And their imagination immediately ran upon the splendid appearance of a sun they had seen in fireworks. They were in hopes their mamma was going to show them something of the kind; but this was not the case.

"You know," said she, "that it is the heat of the sun which causes the water to change into vapor; now, if you place the glass of water near the fire, the heat of the fire will produce the same effect; but still it will take a considerable time to

evaporate the whole, and you will not see the deposit of salt at the bottom of the glass probably before the evening; so you must wait with patience."

"Then to be sure," said William, "if the vapor that rises from salt water is pure fresh water, the salt cannot get out of the sea that way; so it will remain in the sea and make it salt. How very curious it is, that rivers of fresh water should make the sea salt!"

"But then," observed Edward, "as the sea is constantly receiving salt, and has no means of getting rid of it, it must become more and more salt, till at last it will be like brine."

"I said," replied his mother, "that the salt would not rise in vapor, but I did not say that the sea had no other means of getting rid of some of its salt. You may recollect my telling you that there were a great many marine plants growing in the sea; now these plants do not exactly contain sea-salt, but they contain a great deal of soda, and this soda they obtain from the sea-salt, as it is one of the ingredients of which sea-salt is composed."

"Indeed!" said Sophy; "I did not know that salt was made of different things. I thought it was a single thing of itself."

"There are several different kinds of salt," said Mrs. B.; "but they are all made of two things at least, an acid and an alkali—O! but," cried she, interrupting herself, "this is chemistry, and you are too young to understand chemistry, so I shall *tell you no* more than that soda is an alkali which

the marine plants take from the salt, leaving the acid behind."

"Then what becomes of the acid, mamma? if it remains in the sea it must make the sea sour, for acids are always sour."

"Perhaps," said Edward, "the fish may swallow the acid, as the plants suck up the soda."

"Or, perhaps," observed William, "the acid may help to make the shells of shell-fish."

"It is, I believe, all *perhaps*, as you say," replied Mrs. B. "I really cannot tell you what becomes of the acid; I can only say that none of it escapes by evaporation."

"Well," said Caroline, "I thought that there had been but one kind of salt."

"O, Cary!" cried Edward, "don't you know that there are Glauber's salts and Epsom salts in mamma's medicine-chest; then the salt in the sea has not exactly the same taste as that in the salt-cellar. I would much rather drink a glass of salt water than a glass of sea-water."

"The sea contains a great deal of the same salt as that which we eat," said Mrs. B.; "but there is also another salt, much more disagreeable to the taste."

"I do not think our salt at all disagreeable," said Sophy; "meat would be very insipid without it."

"It is true," replied her mother, "that, when we are accustomed to it, salt gives a very pleasant flavor to our food; but do not you remember

how nauseous Friday thought it when first Robinson Crusoe made him taste it ?"

"O, yes ! and the other day nurse let the baby taste it for the first time, and you cannot think what wry faces he made ; and he would not swallow it."

"Are there no salt rivers any where, mamma ?" inquired Caroline.

"I never heard of any," replied her mother, "that contained sufficient salt to make the water taste salt ; but there are many salt springs ; for if a spring, in its passage under ground, happens to meet with a salt-mine, it will melt a quantity of it, and become salt ; but when it rises out of the ground, and flows in a rivulet, it will gradually deposit the greater part of the salt it had melted."

"Just as the river Arno deposits its mud," said Caroline.

"Yes," rejoined her mother ; "and, besides, when it is joined by other rivulets of fresh water, its saltness will soon be destroyed."

"Not entirely, mamma," said Edward ; "for you know it must carry some of the salt all the way to the sea."

"True," replied his mother ; "I should have said that the saltness would have been diminished so much as to make it imperceptible, and not that it would be totally destroyed.

"But though there are no salt rivers," continued she, "you may recollect my telling you that there are some very large lakes, or small seas, in *Asia*, which are salt ;" and she pointed out to

them the Dead Sea, of which they had read in the Bible, and which she told them was so salt that no fish could live in it; and that the country all around was so strongly impregnated with salt that all vegetation was destroyed by it, and it was quite barren.

"O! what a dismal place that must be!" cried Sophy. "Is it not there that the towns of Sodom and Gomorrah were built, and that Lot's wife was changed into a pillar of salt?"

"It is," replied her mother; and she pointed out the spot to them on the map of Palestine. "This sea," said she, "is much salter than any part of the ocean; and a traveller who visited Palestine, attempted to swim in it, but he found it almost impracticable; the water was so much heavier than common sea-water that it bore him up, and made him float on its surface."

"How I should like to swim in that sea, mamma," said Edward, "for I should not be afraid of sinking. I remember, when I was at Newport, I found it much easier to swim in the sea near the beautiful beach there than it is in a pond, because the salt water bore me up much better than the fresh water will. But sea-water is quite clear and transparent, mamma, and does not look thicker or heavier than fresh water."

"It certainly is heavier, by all the salt it contains; but it will not look thicker, for when the salt is thoroughly melted in the water, it becomes invisible, as the salt is which I poured into the glass of fresh water, but it makes it heavier than

it was before, by the additional weight of the salt melted in it; and therefore it is more solid, and better able to bear you up in swimming."

"It does not look more solid," observed Sophy.

"No, perhaps not; but so much solid salt cannot be put into it without making it more solid."

CONVERSATION SIXTEENTH.

RAIN-WATER PURE.—MISTS.—FOGS.—EXHALATIONS. SPRINGS ACQUIRE FLAVOR AND ARE CLEANSED BY RUNNING UNDER GROUND.—NATURAL FILTERS.—EXPERIMENTS ON FILTERS OF VARIOUS KINDS.—MINERAL SPRINGS. — BALLSTON. — SARATOGA.—HOT SPRINGS.

"MAMMA," said Caroline, "if the vapor that goes up into the sky to make clouds, is pure water, the rain which falls from the clouds must be pure water also."

"Perhaps something may happen to change its nature when it is in the sky," said Edward.

"What do you suppose the sky to be?" said their mother; "for it is a term which is very apt to mislead children. They conceive it to mean some particular place or thing, when in fact it is nothing at all, or at least nothing more than the space which surrounds the earth, and extends to the sun and stars. That part which is nearest to the earth is filled with the air we breathe, and in it the clouds are driven about by the wind; but this is much more properly called the atmosphere than the sky."

"Then, can the atmosphere change the water that evaporates into it?" said Caroline.

"No, my dear; it descends as pure as it rose,

but not in the same form; for you know it goes up in vapor, which you cannot see, and it comes down in rain, which you can see."

"Yes, and feel too," said Caroline, "if you are out when it rains, and get wet through."

"Yet I think I have seen vapor," said William. "Are not those thick mists which float along the valley, after there has been a great deal of rain, vapor? I dare say," continued he, "that it is the rain which had fallen evaporating, and getting back to the sky, to make clouds?"

"No," said Mrs. B.; "mists and fogs are something between vapor and rain. They consist of extremely small drops of water, enclosing air; these drops are large enough to be seen, and light enough to float in the air, as you describe, near the ground; but they are not light enough to rise as high as the clouds."

"Yes," said Sophy; "mists do not rise very high; you can often see, from a height above, a mist that is in a valley; but fogs seem to go up to the clouds, and all round every where."

"At least we can seldom see above them, as you say, Sophy; particularly in such a place as London, for example, where the fog consists of exhalations of every description, wet or dry; for there is as much smoke as vapor in a London fog; but, thick and high as it appears, it is very far from reaching to the clouds, unless, indeed, the clouds happen to be remarkably low."

"What do you mean by exhalations, mamma?" *asked* Sophy.

"I mean whatever passes off from other substances and rises into the air from its lightness. Vapor generally exhales from liquids; but there are exhalations also from solid bodies, such as smoke from burning coals, or perfume from flowers."

"Smoke rises from coals and other burning bodies, it is true," said Sophy; "you can see that it is something real, and you can smell it if it gets into your nose, and are almost choked with it if it gets down your throat. But the perfume of flowers is nothing but a smell. I never saw any exhalations rise from flowers, or from any thing that smells, whether it is a good or a bad smell."

"That," replied her mother, "is because the particles are too small to be visible. If the particles of liquids can be so subdivided as to become invisible, why should not solid particles be so too? But you may be assured that whatever you smell is produced by very small particles entering your nostrils, and touching those nerves which belong to the sense of smell."

"I cannot help being surprised," said William, "that rain should be made of pure water; I am sure it neither looks so clear, nor tastes so nice and fresh, as spring-water."

"The rain-water you commonly see has been collected by pipes from the roofs of houses, and been soiled by washing them. If you catch rain-water, as it falls, in a clean plate or basin, it will be quite clear."

William determined to do so the next time it rained, and asked whether it would then taste as good as spring-water.

"No," replied his mother; "rain-water is insipid, because it is pure; for pure water has no taste; while spring-water is brisk and pleasant to drink, because, in running through the ground, it meets with a variety of salts, a small part of which it dissolves, and which, without giving it a decided flavor, prevents its being so insipid as rain-water."

"O! those are the salts which the springs carry into the rivers," said Edward, "and the rivers into the sea."

"But there are some springs," observed William, "that are very unpleasant, as those of Ballston, which taste of sulphur and iron, and all sorts of bad things."

"The waters of such springs," his mother said, "were called mineral waters, because they passed over and dissolved a considerable quantity of those minerals which give them so disagreeable a taste, but which at the same time rendered them very excellent medicines for the cure of some diseases."

"I wonder," said Sophy, "that a spring should be clear, after running through so much dirty ground."

"Nothing," her mother told her, "cleansed water so much as running through the ground."

"O, mamma!" cried Caroline, "I am sure *the* muddy puddles that dirty our shoes so much

when we walk out after rain, are not clear pure water."

"No; but the water of springs flows under ground, and does not stand still, as the dirty water in the puddles you describe. The spring-water, so far from dirtying itself as it flows along under ground, on the contrary cleanses itself; for if any thing dirty happens to be mixed with it, it leaves it behind, adhering to the ground it runs through. This seems strange to you, but I can show you an example of it;" and she took her children to see a machine which filtered water. It consisted of a large vessel, through which the water slowly trickled, and came out through a hole at the bottom. The children saw that the water was thick and looked dirty before it passed through the filter, and was beautifully clear and transparent when it came out. They wondered what there could be inside the filter to wash the water so clean; and what was their astonishment, when, taking off the cover, their mother showed them that the vessel was full of powdered charcoal, through which the water trickled!

"Dirty black charcoal!" exclaimed Caroline, "I should have thought it would soil instead of clearing the water. Look, mamma, how it blackens my finger when I touch it! Why does it not do the same to the water?"

"The water does not rub hard against it as you rubbed your finger," replied her mother; "it runs lightly through it, and if you look well at the charcoal you will see that it is covered with very

small particles of dirt, which the water in its passage leaves upon it."

"How very curious!" said Sophy: "so then instead of the charcoal dirtying the water, it is the water that dirties the charcoal!"

"And by dirtying the charcoal cleans itself," added Edward; "that is very ingeniously contrived."

"The more you learn, Edward," said his mother, "the more you will see that whatever Nature has contrived is admirably done."

"But, mamma," said William, "charcoal is made of burnt wood; is there any charcoal under ground for springs to filter through?"

"No; but there are other things which answer the same purpose; gravel and sand, for instance, or any earth that water can trickle through."

"Then clay will not make a filter," said Edward, "for water will not pass through clay."

"No, certainly; and when the surface of the ground consists of clay, and the rain falls on it, instead of running through, it remains on the clay, and makes the dirty puddles which Cary described."

"Yet the bottom of ponds under ground, or reservoirs, you said, were often made of clay."

"I did; but when there is a great deal of water in these reservoirs, it can be but little soiled by the clay; besides, the spring cleanses itself as it runs through the ground afterwards; just as you see this water cleanse itself by passing through *the charcoal*."

During their play-time, the children were very desirous of making some experiments themselves upon filters, but were at a loss how to contrive it, for it required a vessel with a hole at the bottom for the water to run out at, and all the pots and pans in the house were closed at the bottom. At length, John recollected that garden-pots had a hole at the bottom, and he thought they would answer the purpose of filters extremely well.

"But then," said Sophy, "the water will run through the hole into the ground, and we shall not be able to see whether it is clean or dirty."

In order to prevent this, the children placed the pots in their pans or saucers; having first carefully washed and wiped them, that the water, after having filtered through the pots, might not be dirtied in the pans. The boys then laid two straight sticks across each pan to support the pot, in order that it might not rest on the bottom, and the water be thus able to flow through more easily. They then poured fine gravel into one of the pots till it was about half full; into another, they put sand, and Sophy determined to have one with clay, in order to see what would happen. In a fourth pot, they put some lime, and having completed this, they looked about for some dirty water with which they might make their experiments. The gardener pointed out some in a large tub, which was kept for watering plants, and where it had been standing long enough to be soiled. They filled their watering-pots at this tub, poured

the water over each of the garden-pots till they were full, and then watched with eager impatience to see the result. In a short time the water began to trickle through the pot of gravel and make its appearance in the saucer.

"Here it comes," cried William, with a shout of exultation; "but how slowly it dribbles, drop by drop. However, it is my pot that has begun first."

"No wonder," said Sophy, "for there is much more room for the water to get through the gravel than through the sand or the lime, for the holes are much larger between the little bits of gravel.

"But the water does not look so clear as that which passed through the charcoal filter."

Not being able to account for this, the children ran to their mother, to beg that she would come and see their filters, and explain to them why the water was not so clear.

Mrs. B. thought their filters very well contrived, and told them that the holes, or interstices, as they are called, between the pebbles of gravel were so large, that a good deal of the water passed through without touching them, and that that part of the water which did not touch the gravel could not leave its dirt upon it. "Therefore," said she, "part of the water is cleansed and part remains soiled, and the clean and the dirty parts of the water mixing together, render the water less clear than it would be if every particle of water *brushed off* its dirt upon the gravel."

"I do not understand," said Caroline, "why every drop does not touch the gravel."

"When you pour water from your watering-pot," said her mother, "that part of the water which is in the middle of the stream cannot touch the inside of the spout. Now you may consider the interstices between the gravel as so many small irregular spouts through which the water runs, much smaller, no doubt, than that of a watering-pot, but still wide enough for a good deal of the water to get through without touching the gravel."

"Now here it comes through the pot of sand!" cried Edward, "and look how much clearer it is!"

"I know why," said William; "the grains of sand being much smaller than the pebbles of gravel, the interstices between them must be smaller too, and so the water will be able to brush itself against the sand more thoroughly, and that is the reason it looks so much more transparent; though still it is not so clear and bright as the water from the charcoal filter."

"And I know the reason of that," said Caroline, who, having very well understood her mamma's explanation, added, "it is because the spouts of your pot of sand are not so small as the tiny ones of the charcoal filter, though they are smaller than those of the gravel."

"You are quite right, Cary," said her mother, smiling; "the charcoal being ground to powder, the particles are much smaller than the grains of

sand, and consequently the interstices, or spouts, are proportionally narrower; besides, charcoal is of a nature peculiarly cleansing and purifying. For this reason it is of great importance in long sea-voyages, where the only water to be had, being confined in casks, soon becomes stagnant and corrupt. Now, if the inside of these casks be coated with charcoal, the water, constantly rubbing itself against them, from the motion of the vessel, cleanses itself by depositing all the corrupt parts on the charcoal, and remains sweet and fresh for a long time."

"O!" said Sophy, "I am sure stagnant water is very bad, both to the smell and taste.

"But look at the pot of clay; not a single drop of water has passed through it. Now it begins to trickle from the lime; but this water is not at all clear; it has melted some of the lime, which makes it look like milk and water."

"It has probably washed down and mixed with it more of the lime," said her mother, "than it could dissolve; for, if the lime were dissolved in the water, you would not be able to see it."

"Indeed!" said Sophy, with surprise.

"Do not you remember that, when the salt was completely dissolved or melted in the water, the salt became invisible?"

"O yes! we could see it no more, and I should have thought it had gone quite away, the water was so clear; but I found out it was in the water still, when I tasted it."

"The water always remains transparent when

any thing is completely dissolved in it," said Mrs. B. ; "but water can dissolve only a certain quantity, and if more is put into it than it can melt, part of it will remain unmelted, and therefore will not disappear."

"Then there is more lime in this water than it can dissolve," said Edward, "and so it does not all disappear, but makes the water look milky."

"Very probably," replied his mother ; "or the milkiness may arise from the water not having had sufficient time to dissolve the lime."

"Perhaps so," said Caroline, "for I know it takes some time to melt things ; I always think the sugar takes a long time to melt in my tea, I am in such a hurry to drink it."

Mrs. B. then went to a cupboard, took out a bottle, and poured into a glass some of its contents, which looked like the clearest water.

"Though it looks so transparent, I suspect it is not pure water," said William, "for it smells of lime : may I taste it ?" and his mother having consented, he took a mouthful, but found it so nauseous that he could not swallow it.

"O! I am sure there is lime, and plenty of it, in that water," cried he, making such wry faces that his brother and sisters could not help laughing.

"Yet all that there is in it," said his mother, "is dissolved, for you see that the water is quite transparent and the lime invisible."

"I wish it was invisible to the taste as well as

to the sight," said William, who could not get over the nauseous taste of the lime.

"You may say you wish it were imperceptible to the taste, but you cannot say invisible to any sense but that of sight."

"And you may say imperceptible to any of the five senses, I suppose," said William; "seeing, hearing, smelling, tasting, and feeling?"

"Certainly," replied she.

"Could we make some lime-water like this," asked Sophy, "by mixing lime and water together?"

"Yes," replied her mother; "but it would require great care, and some skill, to mix just the quantity that the water would dissolve; for if you put a grain more it would remain unmelted, and make the water look turbid or milky."

"But if it did not melt," observed Edward, "it would remain a solid grain of lime, so how could it make the water look milky? It seems to me, that it is only by being melted that the lime gets mixed throughout with the water, and thus makes it milky."

"The water, though it would not dissolve the grain of lime," replied his mother, "would divide it into very small atoms, which would be spread all over the water, and give the whole of it a milky appearance. This is called being diffused, or suspended in the water. When, on the contrary, it is dissolved or melted, it becomes invisible, and the water remains clear."

"O! do let us make some lime-water," said Sophy.

"We have plenty of that already," said William, pointing to the bottle; "and then it is so unpleasant! What I should like of all things to make, is some Ballston waters, which smell so strong of sulphur."

"And do you think that nice?" asked Sophy.

"No," replied William; "but as I have only smelled it, not tasted it, I have not such a great dislike to it as I have to lime-water."

"It would be more difficult to imitate the Ballston waters," said Mrs. B., "because they are impregnated with a variety of things; an ingredient in one of the springs is sulphur, which renders it extremely nauseous both to the smell and the taste; and I dare say William would think it still worse than lime-water, if he tasted it. There are," continued Mrs. B., "a great variety of springs in different parts of the world.

"Near Ballston, we find sulphur springs, (or rather springs impregnated with a gas called sulphuretted hydrogen, which emits a very disagreeable odor, and imparts to the water a very unpalatable taste,) and iron, or, as they are called, chalybeate springs, both of which are highly beneficial in many diseases. Near this place is Saratoga, of which you have all repeatedly heard; it being a place of much resort during the warm weather, not only by those who are in pursuit of health, but far more by those who are seeking for pleasure, or are indulging in a little relaxation from

the arduous duties of their respective callings. These springs have become as celebrated as any in the world, for their number and variety, for the agreeable and sparkling vivacity of some, the salubrity and efficacy of others. The waters, besides being freely drunk by the thousands and tens of thousands that annually resort to them, are, in immense quantities, bottled and transported to various sections of the Union, and even shipped to distant places in foreign lands."

"How were these discovered, mother?" inquired Edward.

"It is said, by observing the deer go to them for drink. Some of the springs were known to the Indians, when the whites first settled the country, and were held in great estimation by them on account of their health-restoring qualities."

"Do you know of any other springs in our country?" asked William.

"Yes, the Union abounds with them; there is indeed scarcely a State that does not contain some. Those already mentioned, are the most celebrated. The Lebanon Springs, situated in a village inhabited by Shakers, about twenty-seven miles from Albany, are considerably visited; as are also the Stafford Springs in Connecticut, and the Warm and Hot Springs in Virginia."

"Hot springs!" exclaimed Caroline; "how can the water get hot under the ground?"

"The heat generally proceeds from the spring containing a considerable quantity of sulphur and *iron, which*, when mixed together in certain pro-

portions, produce heat. Some of the Virginia Springs have a temperature of 108 degrees. The hottest spring in Europe is near Naples, known by the name of the Baths of Nero; the heat is equal to 182 degrees, which is within 30 degrees of the temperature of *boiling* water; or, to make it a little plainer, I would say, that, if (212 degrees, which is) the heat of the latter, were divided into seven equal parts, it would be found that the temperature of Nero's Baths is equal to six of them, thus being within one seventh part as hot as the boiling water. The spring of Thuez in the Pyrenees has a temperature of 171 degrees, and one in Auvergne a heat equal to 176 degrees."

"And where does the water get all these bad-tasting things," said Caroline.

"It is too late to answer your question to-day," replied her mother, "as it would lead us into the subject of volcanoes, with which I intend to begin our next lesson."

This delighted the children, for they had just learned enough about volcanoes to excite their curiosity, but very little to satisfy it; and they could not imagine what connection there could be between springs and volcanoes.

CONVERSATION SEVENTEENTH.

HOT SPRINGS OF ICELAND.—VOLCANOES.—ASCENT OF MOUNT VESUVIUS.—DESCRIPTION OF ITS LAVA, CONE, AND CRATER.—LAVA HEATED INTERNALLY SWELLS OUT.—EXPANSION OF BODIES BY HEAT.—ORIGIN OF MOUNTAINS.

"BEFORE taking up the subject allotted for this conversation," commenced Mrs. B., "I will speak of the hot or boiling springs of Iceland."

"Wonder upon wonder!" exclaimed Cary. "It sounded strange enough to hear you, yesterday, tell about hot water coming out of the ground; but still stranger will it sound, to hear of boiling springs in such a dreary, chilly place as *Ice*land must be."

"To us that region of the earth would undoubtedly seem cheerless and uncomfortable, but to its inhabitants it is far otherwise; and no people are more attached to the land of their nativity than the Icelanders, and probably there is none among whom education is more generally diffused. But all presented by the face of Nature is not ice and snow; there are many volcanoes situated here, and it has been not inaptly remarked that the island rests upon a fiery furnace.

"The hot springs are very numerous; at the most remarkable locality, more than fifty may be *counted within* the limits of a few acres, situated

at the foot of a rock about three hundred feet high. The one most familiar to readers, being that respecting which travellers have said the most, is the Great Geyser, as it is called, which is in the vicinity of Mount Hecla. At the time it was visited by Krug Von Nidder, a scientific gentleman, who devoted much attention to the examination of the phenomena exhibited, it presented two kinds of eruptions or ebullitions. The smaller ones occurred with much regularity every two hours, and the water was forced up to a height of fifteen or twenty feet only. The larger ones took place once in twenty-four or thirty hours, and with such violence as to throw the water ninety feet into the air, and the steam still higher, so as indeed to mingle with the clouds. For two hours after the lesser eruptions, the water remained almost boiling hot. After this length of time a dull rumbling noise would be heard from within, the water begin suddenly to reascend, the basin become filled to overflowing, 'immense bubbles of steam burst from the funnel-shaped opening,' and the water be again projected to its usual height.

"The most important spring, next to the Geyser, disappeared, after an earthquake, in 1789, while another, which had previously been a very inconsiderable one, was so enlarged, that it has since equalled, and, as many think, surpassed, the Geyser in grandeur; this is called the Strokr. When Krug Von Nidder visited it, 'a thick column of smoke suddenly burst out, and rose to

the clouds. The water was hurled with terrific violence out of the crater, and mixed like a fine mist with the rest of the column to a considerable height. From time to time, thin streams of water were seen shooting in a vertical or oblique direction through the column of smoke, sometimes rising to a height of one hundred feet and upwards. Large stones, which had been previously thrown in, were flung almost out of sight, and many so perfectly perpendicularly that they fell down again into the crater, and were again thrown up into the air, like a juggler's ball. The whole of the water was ejected at the beginning; and afterwards, the column, which ascended from the opening, was composed only of steam, which rushed out with a whistling and hissing noise, and rose with incredible velocity into the clouds. It continued three quarters of an hour in this state of activity. It then again became quiet, except that the water, deep in the tube, (or cavity,) continued, as usual, to boil violently.'"

The children were now all impatient to hear about volcanoes; but Mrs. B. said, she must first answer Caroline's question, — Whence the hot springs get sulphur and iron, and all such "bad-tasting things," added she, smiling.

"In running through the ground, it sometimes meets with a particular sort of stone called *Pyrites*, which is composed of sulphur and iron; the water dissolves a quantity of this stone, and thus becomes impregnated with both sulphur and *iron.*"

"But," said Caroline, "you told us, mamma, that water cleansed instead of dirtying itself in running through the ground; now, if it picks up such things as sulphur and iron they must dirty it?"

"No, they do not," replied her mother; "the water, after it has dissolved sulphur and iron, is as transparent and beautiful as it was before."

"Or as it is after dissolving lime," said Edward.

"You must remember," continued his mother, "that it is only when things are mixed with water without being dissolved, that the water is soiled by them, and looks thick or muddy, like the lime-water which came from your filter, and contained more lime than it could dissolve."

"O, yes! I understand," said William, "all the lime that was dissolved in the water, did not dirty it, but the lime which was not dissolved did."

"Well then," continued Mrs. B., "when water runs through the ground, whatever dirties it is left behind in the earth as in a filter, and thus the water cleanses itself, but whatever it has dissolved it carries along with it. Let us now proceed to our volcanoes."

"Volcanoes are burning mountains, where there is such a prodigious heat under ground as to make the volcano throw up immense quantities, not only of boiling water, but of fire and ashes."

"O! do tell us all about it," said Sophy;

"you, mamma, have been to the top of Mount Vesuvius, so you must know."

"One does not necessarily know all about a mountain from having ascended it," replied Mrs. B., "and I was not there during a great eruption; the mountain was only throwing up smoke and ashes; the latter, it is true, were still hot from a recent eruption."

"But then did they not burn you, mamma?"

"No; there was no danger of that, for I and the party I was with took care to keep to the windward, so that the ashes fell on the opposite side of the mountain to that we ascended. We left Naples very early in the morning, and began our ascent on mules from the village of Resina, which is at the foot of the mountain."

"I know that village very well," cried Edward, "though I never saw it; we have read so much about it in Miss Edgeworth's story of the Two Merchants."

"As far as our mules could carry us," continued Mrs. B., "our ride was very pleasant; we soon quitted the cultivated ground and reached the lava which had been thrown up by old eruptions, but was not yet covered with vegetation; and as we rose higher up the mountain, we came to the lava of the last eruption, which, having occurred only a few months before, was still warm."

"Can any thing in the open air remain warm for months?" inquired Edward.

"The length of time a body remains hot,"

View of Mount Vesuvius, with the Bay and City of Naples, with the villages at the foot of the mountain.

replied his mother, "depends upon its size, upon the quantity of heat it had at first acquired, and upon the state of the atmosphere. A pocket-handkerchief, washed in boiling water and hung up in the open air, will be cold in a few minutes, long before it is dry; a blanket, being thicker and larger, will keep warm much longer. A tea-cup of boiling water exposed to the air will be cooled, perhaps, in a quarter of an hour, while a tubful of boiling water would require several hours to become cold."

"I wonder how long a river of boiling water would keep hot!" said Sophy.

"Much longer than a tubful, no doubt," replied her mother; "but not so long as a stream of lava, which is a very thick fluid, and when thrown out of the mountain is considerably hotter than boiling water."

"What is lava made of, mamma?" inquired Caroline.

"Lava is a mixture of earths and metals that have been melted by the intense heat of the volcano. When first issuing from the mountain the substance, it most resembles in appearance, is melted iron, which you may recollect having seen pouring from the furnace at the Iron Works we once visited.

"The cavity at the summit of the mountain whence this lava flows is called the crater, and the outside of the crater is in the form of a cone or sugar-loaf. When we reached the foot of this cone," continued Mrs. B., "I was obliged to

dismount, it being too steep for the mules to ascend. The gentlemen of the party continued their way on foot, assisted by the guides, whilst I was carried in an open chair, the man behind supporting the poles on his shoulders, while the one in front held them in his hands, and by this means I was rested on a level. I once attempted to walk, but, though assisted by my two guides, every step I took in the ashes on which we trod, I slipped back almost as much as I had advanced, so that I was obliged to return to my chair, very impatient to reach the summit, and inquiring anxiously of my bearers how broad the space was at the top before the hollow of the crater began. 'Not broad enough for the chair to rest upon,' replied they, 'but we shall take care to support it.' As my head is apt to grow dizzy at the sight of a precipice, this alarmed me; and when we reached the summit they set the chair down upon a ridge of light ashes, so narrow that if I leaned on one side I was in danger of falling down the mountain, and if on the other I might be precipitated into the crater. At first I closed my eyes from giddiness, but the bearers having fastened the poles so as to form a sort of barrier on each side of the chair, I soon became accustomed to my situation, and looked around me with wonder and delight."

"But did not the smoke and ashes which the crater threw up frighten you, mamma?" said Caroline.

"No;" replied she, "they were so completely *blown* by the wind the other way that on our side

we could see down the crater to a considerable depth."

"O dear!" exclaimed Sophy, "suppose some of the burning lava had burst out while you were sitting there!"

"There was no danger of that," replied Mrs. B.; "there are generally some symptoms of agitation before the eruption of lava takes place, and the guides know when it is safe to venture within the crater."

"Within!" cried the boys; "I did not think any one could descend into the crater; how I should have liked to go down."

"O no!" exclaimed the girls, in alarm; "I hope, mamma, you did not go into it?"

"No, my dears; but two gentlemen of the party did. They were slung to ropes, by which they might be pulled up in case of falling, and thus let down into the crater. They received no injury, except burning their shoes wherever they found a spot sufficiently level for them to stand on; and they complained of being half suffocated by the fumes of burning sulphur or brimstone."

"O! I know how bad brimstone smells," said Sophy; "when nurse lights a candle with a match, the brimstone is quite choking; and if a little match, tipped only at the end with brimstone, makes such a horrid smell, what must all the brimstone in the crater of a volcano do!"

"There were many other fumes, no less disagreeable, rising from the crater," said Mrs. B., "besides those of sulphur; but I mentioned that

substance as I knew you were acquainted with it under the name of brimstone. But though there was no lava flowing from the crater when I was there, we were so fortunate, on our return, as to discover a small opening near the foot of the cone, whence a stream of lava, nearly as wide as this room, flowed."

"Do you call it fortunate, mamma?" said Sophy; "I should have been very much terrified! Did not you run away as fast as you could?"

"No, indeed! I was so struck with admiration at the sight, that I did not think of danger; nor was there any cause for apprehension. The lava flowed down the mountain extremely slowly, owing to its being very thick; indeed, if I had not attentively watched it, as it glided majestically down, I should have thought it a motionless solid mass."

"Well," said Edward, "I had imagined that lava rushed down in rapid torrents, overwhelming every thing that came in its way."

"It often does so, in a violent eruption; but the stream I saw, flowed, I should think, at the rate of not more than a mile an hour."

"O, then," said Sophy, "one might stand and look at it as long as one pleased, for there would be plenty of time to run away when it came near."

"Besides," replied her mother, "you would not place yourself in front of the lava, so as to be *in any* danger of its reaching you; but approach

the stream sidewise. The opening which I saw was very insignificant to some of which I have read. The eruption of this same mountain in 1794, occasioned a rent 3,000 feet long and 237 feet broad."

"What a frightful sight this must have been!" exclaimed Caroline.

"Yet even this was small to a rent made at Mount Etna in 1669, which was two and a half German miles in length, and reached one third of the way up the side of the volcano."

"Why do you say *German* miles, mother?" inquired Sophia. "Are not all miles of the same length?"

"Some nations estimate distances differently from others, consequently there is no universal standard regulating the number of yards or feet, which make what is called a mile. Our mile contains 1,760 yards, or 5,280 feet; a German mile is more than equal to 4½ of ours; so is the Austrian, Prussian, and Danish; the Swedish mile is equal to 6¼ and the Portuguese to 1¼ of ours; the Russian mile is less than ours, being equal to only 3,500 of our feet."

"It then behooves a man in travelling abroad," said William, "to make himself acquainted with mileage, or he may suffer much inconvenience. If, for instance, he should be overtaken by nightfall in Sweden, and continue on his journey, because told he should find an inn at the distance of four or five miles, what a long and wearisome

jaunt he would have before reaching his desired tarrying-place!"

"Mother," remarked Sophy, "you said the rent in Mount Etna reached up one third of its height. How high is Etna?"

"By looking at the table which I showed you at a former conversation, you will find it is nearly 12,000 feet high. Traces of the rent were still to be seen in 1819. But a more enormous rent than this was made by the eruption of the Icelandic volcano, Skaptar Jokul, in 1783; this was eight English miles long."

"Pray," said Sophy, "what does lava look like?"

"It is of a dingy gray color, something like melted lead."

"I thought," observed William, "that you said that lava was red hot like iron in the furnace?"

"True; but exposure to the air had cooled the surface, so that it was covered with a gray crust which kept the inside hot."

"Just as pie-crust keeps the apples inside the pie hot," said Sophy.

"Yes," said her mother, smiling at the comparison. "Lava cools remarkably slowly, and is sometimes so sluggish in its motions that I recollect reading an account of some lava from Mount Etna which took two years to move only ten miles; but, it is true, it had flowed down the steep part of the mountain, was in some measure cooled

by long exposure, and was thus creeping on over ground almost flat."

"How very slow," said Caroline; "why, a snail would have crawled faster."

"True," replied her mother; "but to continue my narrative. We went close up to the little stream, and plunging in a stick, it immediately took fire, showing us that the lava within was still red hot. Notwithstanding the pie-crust," continued she, addressing Sophy, "the heat was so great, that we could stop only the instant required to plunge in our sticks, and were then glad to retreat as fast as we could. There had been a slight earthquake on the mountain the night before, and our guides told us that it, in all probability, produced the aperture whence the lava flowed."

"Does an earthquake make a hole in the ground, mamma?" inquired Caroline; "I thought it only shook it."

"When lava is burning under ground," replied her mother, "it swells out, or expands, so as to want more room; and in its endeavor to get room it often shakes the ground. If it happens to be near the opening of the crater of a volcano, it escapes there; if not, it sometimes cracks the ground open and rushes out there."

"But why does it want to get out, mamma?" asked Caroline.

"Because it has not sufficient space within. Since heat makes every thing expand and grow bigger, lava, when burning hot, requires more room to contain it, than when it was cool."

"O, yes!" said Sophy, "I know that when the milk is boiling for our breakfasts, it swells out so much, that though the saucepan is not half full at first, if left on the fire, it froths up so high that it runs over the saucepan into the fire."

"And don't you remember," said Caroline, "that one day there was a tight cover on the saucepan, and nurse was called away just as the milk was beginning to boil, and the milk could not run over because it was shut up by the cover; so it bubbled and boiled, and made a great noise, trying to get out, and at last it burst off the cover, which went bounce! up the chimney, and the milk all ran over into the fire! We thought it such fun!"

"Well," said their mother, "the lava is very similarly situated to the milk boiling in the saucepan. When there is no cover it runs over as it does in the crater of a volcano; and when there is no crater open, it makes such efforts to get out that it shakes the ground, and sometimes bursts its way through the ground above it; that is, it forces open the cover of the saucepan and overflows."

"It must require a great deal more strength," said Caroline, "to force open the ground than to lift the cover of a saucepan."

"And it has a great deal more, to be sure!" said William; "only think what a quantity of lava there must be inside a volcano! all burning hot! —hotter, I dare say, than boiling milk."

"Much hotter," replied his mother; "but the

lava is not only within the volcano, but in all the surrounding country ; it is sometimes so deep in the earth, as to be several miles under ground."

"Then," said Sophy, laughing, "however strong it may be, it can never lift such a heavy cover as that—and so tight too."

"Probably not ; but in struggling for room, it often not only makes the earth *quake* or tremble, but it sometimes heaves it up, by which means it gets more space. There are many places where the earth has been raised from ten to twenty feet by subterraneous fires for several miles in extent, and the lava, having thus made room for itself, has afterwards cooled and become solid ground."

"But," said William, "raising the earth ten or twenty feet, will not make much room for such a quantity of lava."

"That depends upon how far the elevation of the ground extends. Besides moderate upraisings over a large tract, there have been at particular spots some very great elevations. Thus Monte Rosso, near Catania, Sicily, rose, in 1669, 820 feet, in four weeks. And, what seems still more astonishing, Mount Jorullo, in 1759, rose 1,480 feet in a *single* day, being at the rate of more than *a foot a minute during twenty-four hours.* Then, besides heaving up the earth above it, the lava presses also upon that beneath it, squeezing it closer together, and making it more compact, so that it will, perhaps, gain as much space below as above."

"And I dare say it squeezes the ground side-

wise too," said Caroline, "and so makes itself more room every way. I can fancy the lava to be like some enormous animal buried alive under ground, and struggling and striving with all its might to get free."

"But I am glad it is not really a live animal," said Sophy, "it would suffer so much for want of room. Now the lava, whatever strength it has, luckily does not feel."

"No," replied her mother; "and the word *strength* more properly belongs to living animals, which exert their strength; that of inanimate bodies is called *power* or *force*."

CONVERSATION EIGHTEENTH.

POWER OF STEAM.—POWER OF SOLID BODIES SUDDENLY CONVERTED INTO AIR.—GUNPOWDER.—FIRING OFF A CANNON.—EXPLOSION.—CRACKING A WHIP.—DIFFERENT DEGREES OF EXPANSION OF BODIES.—BODIES THAT IGNITE SPONTANEOUSLY.—EXPERIMENTS ON IRON AND SULPHUR WITH WATER.—WATER DOES NOT IN ALL CASES EXTINGUISH FIRE.—EXAMPLE, THE BURNING OF POTASSIUM IN WATER.

"MAMMA," said William, "if there were any houses on the ground which is raised up by the burning lava, I suppose they would be thrown down, for the lava would not lift the ground gently, but with a great shock?"

"No doubt," replied his mother; "and it is this shock which is called an earthquake. The shock is more violent if water is mixed with the burning materials under ground."

"Yet, surely," said William, "water, though boiling, cannot have such power as burning lava."

"I beg your pardon," replied his mother; "the lava is only melted by heat, but the water boils, and is changed into steam, which rushes out of the crater with such force as to drive every thing before it that it meets with."

"I know," said William, "what force the steam has when it rushes out of the pipe of the steam-

boat, every time it stops to take in passengers; it makes such a noise that it almost frightens one."

"It has still more force," said Mrs. B., "when, instead of being let out at that pipe, it is confined within the steam-engine; for it is the power of the steam, struggling for room, that makes the boat move. Steam has been known to force out of the crater large rocks, which had not yet been melted. At Cotopaxi, a block of stone or lava of about 1,000 square feet was thrown sidewise to a distance of 1½ geographical miles. The celebrated traveller Von Humboldt calculated that, at the eruption of the Peak of Teneriffe, in 1798, some of the stones were thrown upwards of 3,000 feet high. At times, water is mixed with ashes, and makes a sort of boiling mud, which rushes out in torrents from the crater, carrying destruction wherever it takes its course. Sometimes prodigious quantities of steam are ejected, which, condensing in the air, fall in heavy showers of rain, doing much damage, as happened during the eruption of Vesuvius in 1794."

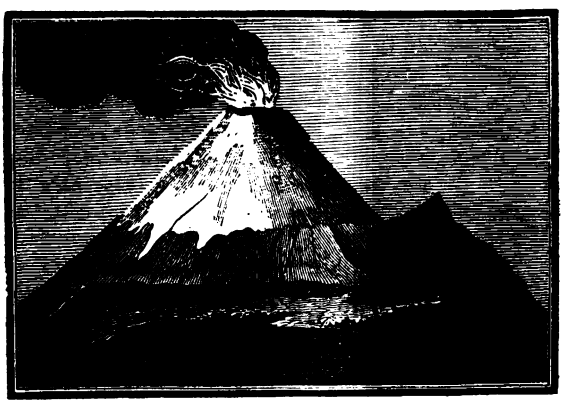
"How frightful!" exclaimed the children.

"But nothing," continued their mother, "produces such violent effects as when the heat under ground suddenly changes some of the burning materials into air."

"How can that be?" inquired William.

"When you fire your little cannon, do you know what it is that drives out the ball with such force?"

"Yes; it is the gunpowder."



Cotopaxi.

"But how can the few grains of gunpowder with which you charge your cannon produce such a prodigious force?"

"I suppose it is by taking fire; for unless you set fire to the gunpowder by a lighted match, the cannon will not go off."

"That is true," replied his mother. "Now you must know that gunpowder is made of such materials, that when it takes fire, it is all at once changed into air, and the few grains of gunpowder in your cannon swell out so prodigiously by being turned into air, that it will make as much air, perhaps, as would fill this room. You may suppose, therefore, how much it will want space, and with what violence it will rush out of the cannon to find it, and in so doing it will drive out the cannon-ball which stands in its way. To give you some idea of the prodigious power of water converted into steam by heat, I need only tell you that the quantity of water which would be contained in a quart bottle, when converted into steam, would fill a space nearly 1,700 times greater."

"And what is it that makes the loud noise when the cannon is fired?" asked Edward.

"No doubt," said William, "it is the ball rushing out with such force."

"No," replied their mother; "the noise or report is occasioned by the rushing out of the new-made air, which strikes with violence against the open air as it bursts from the cannon, and this is called an explosion."

"I wonder," said Sophy, "that air which we

cannot see should be strong enough to make such a loud noise."

"O! Sophy; did you never feel how strong the air is when there is a great wind, and what a loud noise it makes?"

"Yes," replied she, "I forgot that wind was air moving; but the noise is not so loud as that of firing a cannon—a real large cannon, I mean."

"Though we cannot see the air," resumed her mother, "we perceive it both by our senses of hearing and of feeling."

"O! that you do," cried Caroline; "the wind makes one feel so cold; and once, I remember, it was near throwing me down, so I am sure I felt it."

A wagoner, who happened just then to be driving by, cracked his large whip; and William cried out, "Look, mamma, he does not touch the horses, he is only whipping the air that the sound may frighten them and make them go on."

"Yes," replied she, "and it is the striking or cutting through the air with such force that produces the sound. But this is not called an explosion, because there is no air rushing out of a confined place for want of room. It is merely the open air, which is cut in two by the lash of the whip, and then its suddenly joining together again produces the sound."

William was much pleased with this explanation, and after a little reflection, said, "I do think, mamma, that the few grains of gunpowder I charge my cannon with, would make more air

than the room could hold, for don't you remember when I fired it off in the nursery it broke one of the windows, and I dare say that was in forcing its way out; and you told me I must never fire it but in the open air."

"You must consider," replied his mother, "that the nursery was full of air before you fired your cannon; therefore if you make any additional quantity it must find its way out. If the quantity is but small, it will escape through the key-hole, up the chimney, or through any chinks it may find; but if the quantity is large and suddenly added, it will break the panes of glass to make its way out."

"Then, I dare say," said Edward, "if the door had been open, the air would have gone out quietly that way instead of breaking the window."

"No doubt," answered his mother; "the air has no boyish inclination for breaking windows; it is very well behaved, and always goes out by the door unless the window happens to be open, and then, as it has no fear of broken bones, it prefers the shortest way."

The children laughed, and then Caroline said, "How very strange it is, that so small a quantity of gunpowder should produce so great a quantity of air."

"I do not think so," observed her mother; "for in order to be changed into air, it must be divided into particles (which means little parts or atoms) so extremely small that you cannot see them. Each of these particles is separated from

the other, and so far from adhering together, as they did when they were gunpowder, they all fly apart, as it were, and seem to make use of their liberty in separating from each other as much as they can: it is this that produces the expansion, or swelling out of gunpowder when converted into air."

"Then, I suppose, it swells out a great deal more than the lava does when it is burning and melting under ground."

"No doubt," replied Mrs. B.; "therefore when any of the burning materials, instead of being simply melted, are suddenly changed into air, the expansion will be much more considerable, and the effect more violent."

"But is there any gunpowder under ground, mamma?" said Caroline.

"No; not precisely gunpowder; for gunpowder is made by men. But the materials of which gunpowder is made are all found under ground, and when they happen to take fire you may imagine what an explosion it will make."

"But how can they take fire," said Caroline, "for there is nobody under ground with a match to light them?"

"No, certainly," replied her mother; "but some of these materials, when they chance to meet together, take fire *spontaneously*, that is to say, of themselves, without any match to ignite them being required. I think I must ask papa to explain it to you; he is now in his laboratory; and if he is

not too busy with his experiments, we will ask him to show us how this takes place."

They accordingly went to the laboratory; and as soon as their father had finished what he was doing, he inquired what the children wanted, and then showed them a bottle in which there was some iron and some sulphur.

"I do not see the pieces of iron," said Sophy.

"No; because the iron has been made into filings, so that it looks more like a powder than a solid piece of iron; but it is still iron; and if melted, the filings would unite together and make one solid piece of iron." He then sprinkled it with water, and placed it for a short time near the fire; and afterwards shook a little out of the bottle into the air, and, to the astonishment of the children, it took fire of itself.

"How curious!" cried Edward; "and this is what is called taking fire spontaneously."

"Yes," replied his father; "no light was put to it to make it take fire. Now," continued he, "iron, you know, is a metal which is dug out of the earth."

"O, yes!" said William; "I remember the cart-loads of it we once saw at the mines, but it did not look at all like the iron that pots and pans are made of."

"No, because it does not exist in its pure metallic state in the bowels of the earth: it is mixed with earth and a variety of different things, and in this state is called iron ore; it is pure iron only after it has been melted in the furnace; it then

runs out, leaving all the other ingredients behind. Now you must know that in the neighborhood of volcanoes, iron is very often mixed with sulphur and other combustible ingredients of a similar kind."

"But you are not there, papa, to sprinkle water over them," said Caroline, "and without that, you said they would not take fire."

"True," answered her father, smiling, "but there are many other ways of their being supplied with water. Your mamma has told you, that there is a number of reservoirs of water inside the hills and mountains, and little streams under ground find their way from these reservoirs to the surface of the ground, and there burst out in springs; but it often happens that these rivulets, flowing under ground, are stopped in their course and cannot make their way to the surface; and in that case, they gradually dribble down lower and lower through the cracks and fissures they chance to meet with in the earth, till they may at last reach that part where volcanic materials lie: the water will then sprinkle these materials, and they will take fire spontaneously; and the heat produced by their combustion (I mean their burning) will melt them and convert them into lava."

"It is very strange," cried Sophy; "I thought that water always put out fire!"

"So it does," replied her father, "when there is enough of it. But if there is not plenty of water, a struggle takes place between the fire and *the water*, and the fire sometimes gets the better;

then the fire burns the water instead of the water extinguishing the fire. When a house is on fire, the first sprinkling of water that is thrown over it by a fire-engine often only increases the flame; but as the engine continues pouring water on the house, it at last gets the better, and extinguishes the fire.

"Now," continued he, "I will show you something still more extraordinary. Look at this little piece of metal; it is called *potassium;*" and he took a small stick of it with a pair of pincers from a vial. It looked on the outside like the black lead in pencils. He then cut off a piece about the size of a pea, which had a metallic lustre when first exposed to view, and let it drop into a basin of water; when, to the astonishment of the children, it burst out into a beautiful pink flame.

"How very strange!" said Edward; "I am sure there is plenty of water to put out the flame."

"No quantity of water whatever will extinguish the flame of this singular metal," said his father, "until it is thoroughly burnt out; and if this metal, when under ground, happens to meet with water, it will ignite or take fire instantaneously.

"The distinguished philosopher Sir Humphrey Davy, who discovered this singular metal, advanced, and for a time sustained the conjecture, that volcanic eruptions were occasioned by water getting access to large masses of it, buried deep in the bowels of the earth. He however, upon more mature reflection, abandoned this notion. The opinion which seems to meet with the most

favor at the present day is, that the temperature of the earth gradually increases, as it approaches the centre, to an intense heat, and that whenever water comes in contact with this heated matter, it is converted into steam, the great and sudden expansion of which gives rise to volcanic eruptions and earthquakes."

The children were delighted with the experiments they witnessed, and begged their father to show them some more, but he would not consent, saying, "No, my dears, this is chemistry, which you are much too young to understand; and I am not a conjurer to show off a number of wonderful tricks for the amusement of children. So take them away," continued he, addressing Mrs. B., "and let me return to my study."

The children, a little disappointed, went back with their mother to the drawing-room.

"Now," said she, "since we are sent out of the laboratory, I will show you some drawing-room chemistry;" and she took from the chimney-piece a box of lucifer matches, and plunging one of them into a vial contained within the box, it instantly took fire, and burned long enough for her to light a taper with it. "The stuff," continued she, "with which the points of these matches are covered, is neither sulphur nor potassium, but something of the same inflammable nature, (chlorate of potash mixed intimately with sugar,) and the instant it touches the substance contained in the vial, (sulphuric acid, or oil of vit-

riol, as it is commonly called,) it takes fire spontaneously."

"Without even any water?" said Caroline.

"Yes," replied her mother; "but, as papa says, this is chemistry; so you must be content to use these matches without my telling you any thing more about them, until you are some years older."

CONVERSATION NINETEENTH.

ACCOUNT OF THE DESTRUCTION OF HERCULANEUM AND POMPEII, AND THEIR SUBSEQUENT EXCAVATION.—DESCRIPTION OF POMPEII.—EARTHQUAKE NEAR PUZZUOLI.—MONTE NUOVO THROWN UP IN 1538.—RAISING OF THE COAST.—TEMPLE OF SERAPIS.—ACCOUNT OF THE ERUPTION OF VESUVIUS IN 1631—IN 1839.—MOUNT ETNA.

THIS morning, Mrs. B. entertained her children with an account of the destruction of Pompeii and Herculaneum, towns situated near the foot of Mount Vesuvius, and which were swallowed up by an eruption of that mountain in the reign of the Emperor Titus; nearly two thousand years ago.

This eruption she described as beginning by a prodigious quantity of very small black ashes, which arose perpendicularly from the crater, and then spread out into a heavy cloud, producing darkness all around, deeper than that of night. The only light to be seen came from flashes of lightning, which darted from this tremendous cloud, and occasionally a rush of flame from the crater. The earth shook, and the sea receded from the shore; at length the black cloud descended in a shower of ashes almost as fine as powdered charcoal; and at the same moment a *torrent* of boiling mud was cast out of the crater,

which flowed towards the sea, destroying whatever it met with in its course, and burying the towns of Pompeii and Herculaneum deep under ground.

"And what became of the poor people who lived in those towns?" inquired the children, with great anxiety.

"Most of them are supposed to have escaped whilst the awful cloud hung over them; for when the town was excavated, very few skeletons were found; and it is probable they were those of sick people who were unable to fly, or of prisoners; for some few of them were in chains. One poor lady and her family took shelter in a cellar under ground, where they remained safe from the shower of ashes; but the boiling mud which afterwards poured down the mountain forced its way into the cellar and destroyed them all. And though it is not many years since their bodies were discovered, the bracelets and other jewels they wore at the time of their destruction were found hanging on their skeletons."

"O dear! I should not like to live near a volcano," observed Sophy. "But was there no lava?"

"There was no lava cast out by that eruption, but it is probable there was some burning deep under ground, and that it was its combustion, which heated the water and produced the eruption of boiling mud I have described."

"And," said Edward, "the eruption of such a prodigious quantity of ashes and of mud, must

have left plenty of room for the burning lava below, and I dare say that is the reason it did not come out itself."

"What an immense quantity of water," observed William, "there must have been, to melt so much earth and change it into hot mud; I think more than one spring of water must have supplied it."

"It is not improbable," said his mother, "that the sea may have made its way under ground, and have found access to the lava; for Vesuvius," added she, pointing it out on the map of Italy, "is, you see, very near the sea.

"Herculaneum and Pompeii were not discovered for many centuries after this eruption, and they were then found by accident in digging a well; and have since been in some measure brought to light again. The greater part of Pompeii has been completely cleared, the earth which covered it having been dug out; and it is wonderful to see how fresh and uninjured the buildings appear."

"How I should like to see it," said William; "it must be so curious to walk in streets that were trodden so many hundred years ago! And are the houses like ours?"

"No; they are considerably smaller, and built for a warmer climate, each having an open court, which is generally ornamented with paintings, and a fountain in the middle; and this spot appears to have been more inhabited in the day-time than the enclosed apartments, these being destined *chiefly for* sleeping-rooms. The paintings on the

walls of the houses, the furniture, utensils, and ornaments have been wonderfully well preserved, considering the time they have been buried; and they are now removed to a museum at Naples, in order to be well taken care of. The theatres, both at Pompeii and Herculaneum, are very magnificent, and richly decorated with statues, a great number of which are extremely well preserved.

"After the eruption which destroyed these two cities," continued Mrs. B., "the volcano remained tranquil a great number of years."

"No wonder," said William; "having thrown up such a prodigious quantity of things, there must have been plenty of room for the subterranean fire to burn and swell the lava without its overflowing."

"Many years after," continued Mrs. B., "these fires began again to be very troublesome in the neighborhood of Naples, which, during two years, was continually disturbed by earthquakes."

"O! I wonder," said Sophy, "whether there is going to be another eruption of Vesuvius, or whether the subterranean fires will split open the ground and get out somewhere else."

"These earthquakes," resumed her mother, "went on increasing both in frequency and violence, till at length a gulf suddenly opened in the ground, close by a small town called Tripergola, near Puzzuoli, in the Bay of Naples, and an eruption, consisting of solid blocks of unmelted lava, mixed with ashes and flame, took place, and in the course of about three days a quantity was

thrown up which formed a mountain no less than four hundred and forty feet high."

"But why was not the lava melted, mamma?" inquired Edward.

"Probably the eruption of hot air and vapor drove out the masses of lava before them, without having had time to melt them."

"O, yes!" said William; "the hot air and vapor were the gunpowder, and the masses of lava the cannon-balls which they fired off from the gulf below."

"It was fortunate," said Mrs. B., "that this gulf did not open in the town itself, as it gave the inhabitants time to escape before their town was overwhelmed. This mountain has obtained the name of Monte Nuovo, or New Mountain, and was raised in the year 1538. I visited Monte Nuovo, when I was at Naples; it is of a very regular form."

"It must look like those immense heaps of ashes that are sometimes seen in the suburbs of large cities, I suppose," said William.

"Originally it might, perhaps," replied she; "but that is so many years ago, that there has not only been time for a soil to form upon it, but it is now covered with a rich vegetation of myrtles, arbutus, and other beautiful evergreens. I am sorry I can show it you only on the map," continued Mrs. B., pointing it out to her children; "and here is another mountain, called Monte Rossa, which was raised in a similar manner, and at a much earlier period, so that we have not any *exact* account of it.

"I must not forget to tell you," added she, "that the eruption which produced Monte Nuovo raised the sea-coast in the neighborhood many feet. I saw there the ruins of a very ancient temple, called the 'Temple of Serapis,' the columns of which are perforated with holes made by shell-fish which are lodged in them. It is evident, therefore, that the temple must once have been under water to that depth, for the shell-fish to have made these holes and lodged in them. Now, since the temple could not have been built under water, the ground on which it stands must have been originally dry, and must afterwards have sunk under water to half the height of the columns, have remained so a number of years, and then, in the year 1538, have been again raised above the level of the sea, and is now on dry land."

"I should have thought so much dancing up and down," said Sophy, "would have thrown down the columns, and dashed them and the temple all to pieces."

"Several of the columns, as well as various parts of the building, lie scattered on the ground, and there are but three that remain standing."

"I wonder this eruption did not come out of the crater of Vesuvius," said Edward, "since it is so near?"

"Not so near as you would imagine," replied his mother; "I dare say there is a distance of fifteen or twenty miles between the two mountains. Besides, at that time, the crater of Mount

Vesuvius had been so long undisturbed by eruptions, that the lava around had fallen in and closed it up."

"Then do you suppose," said William, "that there is a communication between Monte Nuovo and Vesuvius, under ground, so that if the lava escapes at the one, it will be quiet at the other?"

"In all probability," replied his mother, "there are a great many cavities under ground, such as those where the water collects and forms reservoirs for springs, and these frequently communicate together by subterraneous passages, especially in volcanic countries; for where so much lava and ashes is thrown out, the greater must be the cavities within, when all is quiet. A traveller, who visited Mount Vesuvius in the year 1631, nearly a hundred years after Monte Nuovo had been thrown up, gives a very interesting description of the state of the crater at that period. He says it was five miles round, and about a thousand paces deep: at the bottom was a plain, on which cattle grazed; and in the wooded parts wild boars frequently harbored."

"How very different," exclaimed Sophy, "from what it was when you ascended it, mamma."

"The only volcanic vestiges that remained," continued Mrs. B., "were in one corner of the plain, which was still covered with ashes, and amongst them were three small pools of water. In one of them it was hot and bitter; in another it was salter than the sea; and in the third it was *hot, but* tasteless."

"There must have been a great number of years without an eruption, for the crater to have been thus closed up, and for the grass and trees to have had time to grow," said Edward.

"Very true; the formation of a soil, deep enough to support trees, requires a prodigious length of time; but long as it took to rear them, they were all destroyed in the course of a few hours; for, at the latter end of the same year, 1631, an eruption took place, in which no less than seven torrents of burning lava burst from the newly-opened crater, together with prodigious streams of boiling mud, which overwhelmed and destroyed whatever came in their way. Ever since this period the mountain has been more or less agitated, and few years pass without the recurrence of an eruption."

"Well," said Sophy, "I wonder that any body can be so foolish as to live near such places. I am sure that, if I did, I should never go to bed without looking at the mountain, to see if there were any flames burning or any ashes thrown up."

"You would not do so," said her mother, "if you were accustomed to see the mountain in this state, and yet no eruption take place. Indeed, so careless do the inhabitants of that neighborhood grow to their danger, that even repeated warnings are of no avail: they constantly rebuild, on the same spot, towns which have been destroyed by eruptions; and Torre del Greco, in particular, which is situated between the mountain and the sea, has, I believe, been no less than fourteen

times destroyed and rebuilt. One of the most recent destructions of this place occurred during the evening of the 15th, and morning of the 16th of June, 1794. The lava spread through all its streets, and then flowed into the sea, covering its bed over a space three hundred and sixty-two feet long, and eleven hundred and twenty-seven feet broad. 'When the lava ceased to flow,' says a recent writer, 'the crater was covered by a dense cloud of finely-pulverized pumice, which enveloped it for four days, during which time the summit of the mountain fell into the internal cavity. The country, for ten or twelve miles around, was wrapped in a midnight darkness, and thunder-storms were awfully frequent. During the eruption, volcanic sand fell to the average depth of fourteen inches, for a distance of three miles round the mountain. It is impossible to describe the horrors of that night, in which Vesuvius poured out its terrible fury on the beautiful valley beneath it. The fiery ejections and the inexpressible groans of the mountain, the death-like stillness of the atmosphere, and the cries of the thousands who had been driven from their homes and all the pleasures of life, must, together, have presented a combination of terrors which no imagination can realize.'"

"What a dreadful state of things, and how the little children must have been frightened!" remarked Caroline.

"Yes, it was an awful thing, not only for the *young*, but for people of every age."

"Has there been any recent eruption of this mountain, mother?" inquired William.

"Yes; one commenced on last new year's day, (1839.) It began with an explosion, like the discharge of a cannon, and a dense cloud of ashes and smoke soon hovered over the city of Naples, to the no small consternation of its inhabitants. Fortunately, the wind changing carried it in another direction. On the evening of the second day, the entire mountain seemed on fire, and the lava flowed down its sides, committing extensive ravages. On the third evening, a phenomenon of very rare occurrence took place, which was, the issuing forth of continual flashes.

"When I first went to Naples, arriving after dark, I was a little startled at the sight of the fire issuing from the crater, which being more abundant than usual, much expectation was entertained that a great eruption might take place; but, far from dreading it, travellers, like myself, were eagerly hoping it would take place; and I soon learned to be as desirous of seeing a great eruption as others."

"But could you see it without danger?" inquired Sophy.

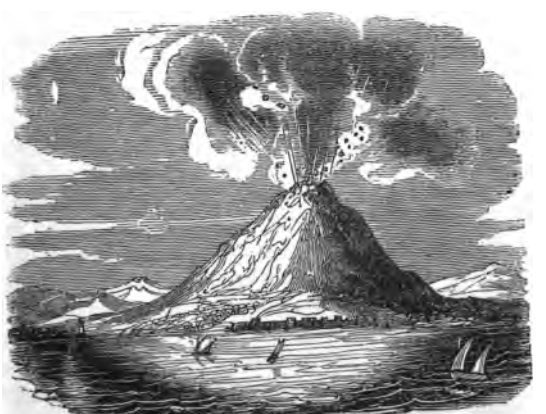
"O, yes! when an eruption occurs, the inhabitants of Naples, so far from flying, are all flocking towards the mountain; and I know one English family who took up their abode, for several days, in a sort of hermitage, situated about half way up the mountain, in order to see the eruption more completely. Perhaps there was some risk in

venturing to remain so very near, but none of them suffered any inconvenience from it."

"It must be such a magnificent sight!" said William, "that it would be worth while to run some risk, in order to see it thoroughly."

"Before closing our conversation," observed Mrs. B., "I must briefly allude to Etna. This mountain consists almost,if not entirely,of lava; it rears itself aloft in imposing grandeur, to the height, as already mentioned, of nearly 10,000 feet above the level of the sea, and in circumference is not far from 180 miles. The earliest reference we find made to it is by Thucydides.

"Diodorus Siculus informs us that a Carthaginian army, whilst on its march against Syracuse, was arrested in its progress by the flowing lava. One of its most remarkable eruptions occurred in 1669, when fifteen towns and villages were destroyed, and the stream of lava was so deep that it flowed over the walls of Catania, sixty feet in height, ruining a part of the city. Many fissures were formed; one of which, in the plain of St. Lio, was twelve miles long and six broad."



View of Mount Etna.

CONVERSATION TWENTIETH.

SUBMARINE ERUPTIONS.—NEW ISLANDS IN THE MEDITERRANEAN.—ISLES NEAR ICELAND. — MOUNT HECLA.—HOT SPRINGS.—NUMBER OF VOLCANOES IN AN ACTIVE STATE.—ORIGIN OF MOUNTAINS.

"I WONDER," said William, "whether there were ever any eruptions of burning lava at the bottom of the sea?"

"If there were it could never be known," observed Edward; "for there would certainly be water enough to put out the fire immediately."

"But suppose," said Sophy, "there was a very, very great eruption from the bottom of the sea, it might throw up ashes and make a Monte Nuovo under the water, which would, perhaps, rise up as high as the surface of the sea, and then it would make a sort of new island like that which mother once told us about—O! how funny that would be! And when ships passed by, the sailors would say, 'I wonder what that little island can be! I never saw one there before.'"

"And then," cried Caroline, "if the eruption was strong enough to get the better of the sea, when it was under water, I don't think it would stop, when it got above the water, and had nothing to hinder it; but it would go on throwing out ashes and lava, and all sorts of things, and so there

would be a volcano in the little island, and that would be prettier still !"

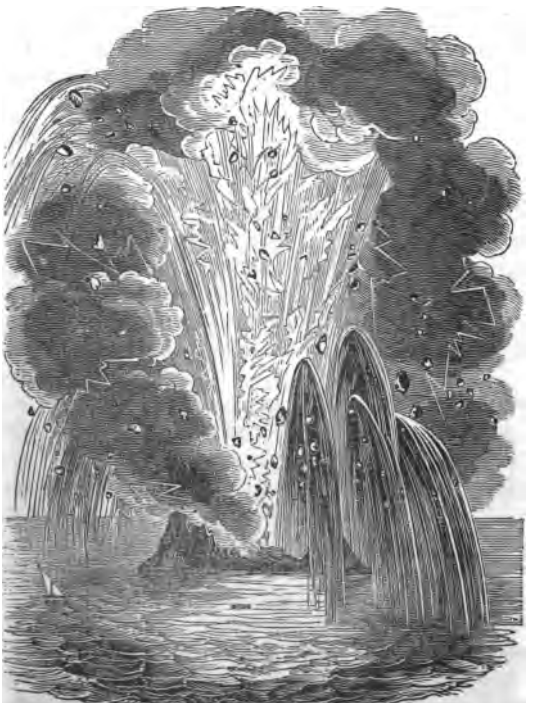
"But, mamma," said Edward, "you do not say a word about it, so I am afraid that it is impossible, and that we are only building castles in the air."

"Or, rather, castles under the water," said William, laughing.

"I would not interrupt your discussion," said their mother, "because I like to hear you argue without my interference, especially when you are in the right track. What your imaginations have just led you to describe is not only possible, but really takes place. No doubt, as William says, many submarine eruptions have been extinguished, without coming to the knowledge of any one ; but there have been many of these eruptions, which have cast up such large quantities of lava and other solid materials, that they have at length raised mountains whose summits have reached above the surface of the sea, and formed islands of a conical or sugar-loaf form, with an eruption going on from the crater."

"How very wonderful !" said William; "what power these eruptions must have had, to have pushed their way through such an immense body of water as the sea, without being extinguished."

"Such an island," continued Mrs. B., "arose in the Mediterranean Sea, not very far from Sicily, so lately as the year 1831. It was first discovered by the crew of a vessel, who were surprised at the appearance of a prodigious quantity



View of the Volcanic Island in the Mediterranean Sea, southwest of Sicily, raised by a submarine eruption, in July, 1831.

of cinders, which had floated to such a distance from the volcano, that they were surrounded, and the progress of the vessel in some measure impeded, before the volcano itself was discovered."

"And was the sea deep there?" inquired Sophy.

"It was six hundred feet deep, and, as the crater rose more than one hundred feet above the water, you may imagine what a quantity of solid materials must have been thrown up. The eruption continued in activity, and the island consequently increased in size, during a month: it then remained stationary till the following winter, when a great storm arose, and it was swept away by the waves."

"So the sea revenged itself at last on the volcano that had set it at defiance," said William.

"It could only conquer after the volcano was dead,—I mean extinguished," said Edward; "that is a mean sort of vengeance."

"All vengeance is worse than mean," observed Mrs. B.

"Well, I am quite disappointed," cried Caroline, in a tone of regret; "I thought that the island, after the eruption was over, would have had trees and flowers grow upon it, and that it was possible, some day or other when I was grown up, I might see it."

"The submarine volcanic islands are of a very fragile nature," said her mother; "for the cinders and lava lying loosely over each other, the waves, with which they are surrounded, can

easily penetrate between them, and wash them away ; there are, therefore, but few instances of such islands becoming permanent ; and those not in situations you are ever likely to visit. Still there are some which sustain vegetation, and on which man has ventured to erect his habitations, and indeed take up his permanent abode. The island of Santorino, in the Grecian Archipelago, is of this description. Several other islands have at various subsequent periods occurred in the vicinity of this, and most, if not all of them, are now inhabited and cultivated. Another new island seems about to make its appearance within nine hundred feet of Santorino. Thirty-five years ago, say the islanders, there was a bank at the spot spoken of, ninety feet beneath the surface of the water ; in 1820 it was only sixty feet beneath ; it is now less than fifteen, and the bank continues rising so rapidly it is conjectured that it will ere long emerge, and take its rank with the other islands. Among the small islands near Venice, an island was thrown up in 1713, accompanied with flames, smoke, and the most vehement shocks ; two years afterwards, another island appeared under similar circumstances ; both of these are now inhabited. But, as already remarked, most of these islands are of a very fragile nature, and remain but a short period above the surface. One of these islands made its appearance in July, 1830, southwest of Sicily, in the Mediterranean Sea ; it was preceded by a noise like thunder, by the ascent of columns of smoke

to a great height, and by the projection of a vast quantity of black-colored water, eighty-two feet into the air. In the course of six months, this island, which was twenty-one hundred feet in circumference, and elevated at its highest point two hundred and ten feet above the sea, entirely disappeared.

"In the year 1811, large black columns of ashes were seen rising out of the sea, eight hundred feet in height, near the island of St. Michael, one of the Azores, whence we have such excellent oranges. From these columns issued flashes of lightning, and explosions loud as thunder, and in the course of time, this eruption produced an island, to which I have once before alluded, called Sabrina; but its fate was like that of most of them, it was either washed away or sunk down into the sea. Several islands of this description," added she, "have been thrown up on the coast of Iceland. Of these I will only mention one that appeared in May, 1783; so large a quantity of pumice was cast forth from its crater, that it covered the ocean for upwards of one hundred and thirty miles; in a short time, however, it sank again, leaving nothing but a rocky reef to mark its former abiding-place."

"There must be a great deal of subterranean fire in the neighborhood of Iceland, judging from what you have now and formerly told us," said William; "is not that strange in so cold a place?"

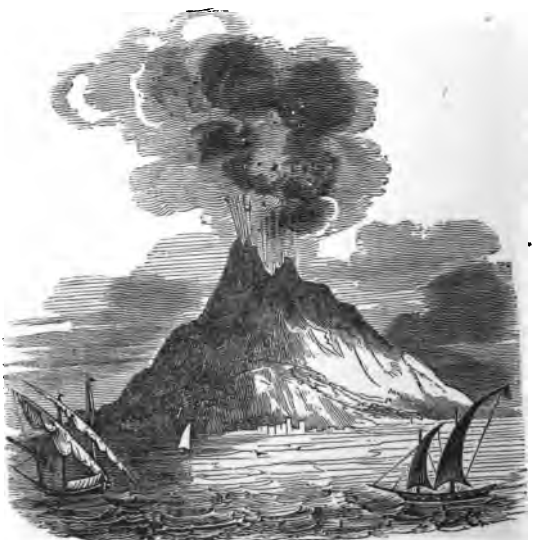
"The subterranean fires, buried deep in the

earth," said his mother, "are not affected by the coldness of the external air. There are no less than three volcanoes in Iceland, of which Mount Hecla is the most remarkable. Its eruptions have sometimes lasted five or six years without ceasing, and have thrown out more lava than any other volcano. Another of the Icelandic mountains, that has often desolated the surrounding country, is Skaptar Jokul. In 1783, it 'ejected a considerable torrent of lava, which, running into the river Skapta, dried it up, and overflowed the fields beyond it, though in some places the bed was nearly two hundred feet wide, and more than six hundred feet in depth. A deep lake was filled with the lava, and a subsequent current was precipitated over a tremendous cataract called Stapafoss, where it filled a profound abyss which that great waterfall had been hollowing out for ages, and after this the fiery current again continued its course;' it is supposed to have spread over a surface equal in extent to sixty geographical square miles; and the mass in magnitude was greater than Mont Blanc.

"Earthquakes also frequently shake this island in a tremendous manner, throwing down the hills in some places and heaving up new ones in others; and, in the interval of the eruptions, the subterranean heat finds a vent in the hot springs of water for which this island is remarkable, and of which I gave you some account in a former conversation."

"No wonder," said Sophy, "with so much subterranean fire, the water from the reservoirs

View of Mount Hecla.



View of Stromboli.

should come out in springs boiling hot. But is there no cold water there ?"

"O yes ! in those parts of the island that are inhabited, and which are sheltered from the effects of these eruptions, the people suffer from cold instead of heat."

"Well, I should not like to live in any part of it, cold or hot," said Sophy ; "but I should like just to go and see one of those curious new islands. Can you tell us, mamma, how many volcanoes there are in the whole world ?"

"The number of those which are still in a state of activity, that is, which occasionally have eruptions, I suppose you mean ; for the number of those that are completely extinct could not be counted."

"Yes," answered Sophy, "I mean those that are still volcanoes."

"I do not know, exactly," replied she. "There are five or six in Europe, reckoning three in Iceland, Etna in Sicily, Vesuvius in Italy, and Stromboli in the Lipari Islands. But there is a much greater number in the other quarters of the world. There are no less than sixty, in a state of activity, in Chili ; and I have heard that there have been reckoned above two hundred in all."

"Then, but a small number of them are represented on the map of the mountains," observed Edward ; "see how few there are with fire coming out of the craters."

"No doubt," replied Mrs. B. ; "not are all

the mountains represented. A selection is made of a few of the principal mountains, as well as volcanoes, in each quarter of the world. In former times there was a much greater number of volcanoes than there is at present; at least, if we may judge from the number that are extinct."

"But they were probably not all in a state of activity at the same period of time," said William.

"No, certainly. There is a range of very small extinct volcanoes along the southern coast of France, near Montpellier; and the mountains of Auvergne are generally of that description; but they have been so many centuries in a state of tranquillity, that the period of their being in activity is unknown."

"Then how can you tell that they ever were burning mountains, mamma?" inquired Sophy.

"Because the materials of which they are formed are of the same nature as lava. Besides, many of them retain the form of a crater; and, if they have not a distinct cavity at the summit, there is at least a depression, and they are never terminated by a pinnacle, such as are seen in the Alps, and other mountains that are not of a volcanic composition."

"And do you suppose, mamma," said William, "that all volcanoes were first made by eruptions, like that of Monte Nuovo, and the submarine volcanoes?"

"Probably," replied his mother; "and many naturalists are of opinion that the mountains which

are not volcanic, nor have ever been so, also owe their origin to subterranean fire."

"How can that be?" inquired William; "when you say that there is no lava in their soil, and no remains of a crater at their summits?"

"You may recollect my telling you that the commotion the ground underwent, when subterranean fire was burning beneath, often raised it above the common level. Now if, in the course of ages, this effect frequently recurs, it may produce an elevation not only of some hundred, but of some thousand, feet. In short, it may raise up a mountain."

"Like Monte Nuovo, mamma," said Sophy; "but in a very different manner, for it pushes it up, instead of pouring it over."

"True," replied her mother; "and who can say that the chain of the Alps, of the Appenines, or of the Andes, may not in this manner have originally arisen from the level earth?"

"But, then," said William, "if all the mountains are produced by subterranean fire, there must be subterranean fire every where!"

"No," replied his mother; "for there are not mountains every where. In Asia and Africa there are sandy deserts, of immense extent; and in this Country, and many parts of Europe, there are grass plains, several hundred miles across, and all these are nearly level. Besides, though there may possibly have once been subterranean fires, where now there are mountains, that fire must have been extinct for ages past, since there are

no vestiges of it, either in the regions of the Alps, or in any other range of mountains, that are not volcanic."

"Then, mamma," said Sophy, "was the earth level every where, before the subterranean fires began to burn?"

"In all probability, it was uniformly level when it was first created."

"O! how ugly and dull it must have been for those who lived in it then, mamma!" said Cary; "I shall be almost inclined to forgive these dreadful volcanoes some of the harm they do us, if they are the cause of all our pretty hills and snowy mountains."

"We know not how soon subterranean fires may have burst out in the form of volcanoes, or have heaved up mountains by inward pressure," replied her mother; "but we are certain this must have happened before the creation of man, or, indeed, of any living beings; for it is not till after these mountains were raised, that reservoirs of water could be formed in them, and that springs could have issued from them, and rivers flowed; and yet these would be necessary for the existence of living beings, whether animal or vegetable."

"And these rivulets and rivers," observed William, "wearing themselves beds in the valleys, as they flow along, will have helped also to destroy the original level of the ground?"

"True," said his mother; "especially when, under the form of a cataract, they rush headlong

down a precipitous mountain, wearing away the solid rock, and sometimes splitting it asunder."

"I wonder," said Sophy, "that there are no chains of burning mountains: what a grand sight it would be to see a whole row of volcanoes burning together!"

"Even supposing they stood in a row," replied her mother, "it is not probable they would all be in a state of eruption at the same time; for when the lava found its way out at one volcano, being no longer pressed for room, it would not force its way out at another."

"I will tell you why there are no chains of burning mountains," said William. "When fire is burning under ground, and striving to get out, it can more easily force its way through a level plain, than through a chain of mountains, because it must have less earth above it."

"I do not understand that," said Sophy.

"Why, Sophy," continued William, "if you were under ground, and striving to get out, which would you like best—to have a plain or a mountain over your head?"

"Yes," said Sophy, "I should like a plain best; because I should have a less quantity of earth over me, and I should have a better chance of getting out there."

"Well," continued William, "so it is with the subterranean fire; if it happen to be under a range of mountains, it may strive in vain to make its way through them; perhaps, by great efforts,

it might push up a mountain, but it would not get through and make a volcano."

"Well, but," observed Edward, "if, as mamma says, the earth were level everywhere when it was first created, there must have been a plain everywhere; so that the mountains must have been made in a plain, whether they were volcanoes or not."

"But," replied Sophy, "when a mountain is only pushed up by internal fires, without their being able to get out, the fire will go on burning under ground, and still be in want of room: what will it do then?"

"O! then," said Edward, "as it cannot get out there, it will try at another place, a little further on, and push up another mountain; and if it cannot escape there, it will try again, and push up a third mountain; and so it will go on, pushing and pushing, till a whole chain of mountains is made."

"I understand that very well," said Sophy; "but why should there not be a chain of volcanoes made in the same manner?"

"Because," said Edward, "the fire making its escape at the crater of the first volcano, there is no need of pushing up any where else; for the eruption will go on, and the lava and other things be thrown out, as long as there is any want of room under ground. Is it not so, mamma?"

"I would not interrupt your argument," replied she, "because it appeared to me ingenious; *but I fear* that I cannot vouch for its being exactly

true ; for the largest of the volcanoes known are in the two greatest chains of mountains, the Andes and the Himmaleh ; (the locations of which you will find by looking on your map ;) and though it is true that there are few chains of mountains formed of volcanic materials, there certainly have been chains of volcanoes. Most of the conspicuous mountains of Auvergne, I have already told you, are of that description ; and there are no fewer than sixty extinct volcanoes in the immediate neighborhood of Monte Nuovo, between Naples and Cuma."

CONVERSATION TWENTY-FIRST.

ON EARTHQUAKES.—THAT OF LISBON IN 1755 DESCRIBED.—EARTHQUAKES IN CHILI.—RAISING OF THE COAST.—ERUPTION OF TOMBARO, IN THE ISLAND OF SUMBAWA.—EARTHQUAKE AT ALEPPO.

"To-day," said Mrs. B. to her children, "I mean to tell you something about earthquakes."

"O! we shall be so glad to hear about earthquakes," cried the children.

"I cannot give you an account of one from my own knowledge, for I never felt an earthquake; but I recollect, when I was a child, hearing a description of the great earthquake at Lisbon given by a gentleman who was on the spot; this earthquake was the most violent one that ever occurred in Europe, so far as history shows."

"Do pray tell us, mamma, all about it," said William.

"It happened," resumed Mrs. B., "on the first of November, 1755. A sound like thunder was heard under ground, which was followed by a tremendous shock."

"It was no doubt produced by the violent efforts of the subterranean fire to get vent," said William.

"Certainly," replied Mrs. B.; "it was some *terrific* internal struggle. But I will try to give

you the gentleman's account of the earthquake in his own words,as far as I can recollect them.

" ' I was in bed, and being suddenly awakened, I beheld the pictures which hung on the walls of my room, swinging to and fro with great violence. The idea of an earthquake immediately suggested itself to me. I leaped out of bed and ran to the window, and on opening the blind, the first object which caught my eye was a neighboring church steeple, which rocked from side to side, and then fell with a tremendous crash to the ground. I rushed into the street, which was thronged with crowds of people flying towards the sea-shore ; I had stopped an instant under the gateway of my house, thinking that its solid arched roof might withstand the shock and afford me protection, but I saw it totter, and I joined the multitude, who exposed themselves to be crushed by the falling buildings in their way to the shore. Amid the dreadful scenes we witnessed in our way thither, one which particularly struck me, was the appearance of a coach which had sunk into a chasm that had opened beneath it as it rolled along. It was the fashion at that time to ornament the roofs of carriages with plumes of feathers, such as are seen now only in England and some other parts of Europe, at funerals. The four plumes and the roof remained on a level with the ground, every other part of the carriage being buried in the chasm.' "

" And what became of the poor people in the carriage ?" inquired Sophy.

"It is but too probable that they were crushed to death; but the gentleman was in such imminent peril, himself, that he could not stop to inquire. He hurried on, and was so fortunate as to be one of the number who reached the sea-shore. 'We there got into a boat,' continued he, 'and thence into a vessel in the harbor, where we returned thanks to Heaven for our miraculous escape.'"

"But did not the earthquake shake the sea as well as the land?" asked Sophy.

"Certainly; but a ship in the water can bear shaking much better than a building on land."

"A ship, you know, Sophy," said William, "is made to be shaken by the waves and the wind when there is a storm."

"'The effect of the earthquake at sea,' continued the gentleman, 'was most awful. The water at first receded, leaving the shore dry much below low-water mark; it then seemed to gather itself into one large mass, forming a tremendous wave, which rolled forward on the shore more than fifty feet above the usual level, and if the vessel in which we had taken refuge had not been manœuvred with great skill, in order not to be dragged away by this wave, we must have perished.'*

* It is related by an eye-witness, that he saw the walls of several buildings separate to the distance of a quarter of a yard, from top to bottom, and then unite again, so completely, as to appear as perfect as they formerly were, and to leave no marks of any rent. There were no less than thirty thousand individuals destroyed in Lisbon, alone. Mr. Wolfall, *who was present*, observes, "The sight of the dead far exceeds

"The distance," continued Mrs. B., "to which this earthquake extended, was very remarkable. Nearly the whole of Europe and the West Indian Islands felt the shock on the same day. In the north of Africa it was, in many places, as violent as at Lisbon. A village near Morocco was swallowed up, and the earth closed over it; and a sea-port about twenty miles from Lisbon, was ingulfed in a similar manner. The largest mountains in Portugal were shaken to their foundations; and many of them were rent asunder with such violence, as to throw huge masses of them into the adjoining valleys. Indeed the shock extended to this country, and Lake Ontario became much agitated. Lisbon contains an aqueduct which is considered one of the greatest pieces of

all description; for the fear and consternation were so great, that the most resolute person durst not stay a moment to remove a few stones off the friend he most loved, though many might have been saved by so doing; but nothing was thought of but self-preservation; getting into open spaces and the middle of the streets, was the most probable security. Those lost in houses and streets are very unequal, to those that were buried in the ruins of churches; for as it was a day of great devotion, and the time of celebrating mass, all the churches in the city were vastly crowded, and the number of churches here exceeds that of both London and Westminster; and as the steeples are built high, they mostly fell with the roof of the church, and the stones are so large that few persons escaped being killed by them.

"I lodged in a house where there were thirty-eight inhabitants, and only four were saved. In the city prison eight hundred were lost, twelve hundred in the general hospital, and in a great number of convents, four hundred each. The palace tumbled the first shock, but the natives insist that the inquisition was the first building that fell down."

workmanship of modern days ; and although it stretches ten miles in length, and some of its arches are one hundred feet wide and two hundred feet in height, it is not a little singular, that the structure remained uninjured, amid the widespread desolation that reigned around."

"What a dreadful country to live in!" exclaimed Sophy ; "I am very glad we have no great earthquakes here."

"And yet," said Caroline, "I should like to feel a little tiny earthquake, just to know what it is like ; but where there was no danger of houses falling or of being swallowed up."

"Such earthquakes occasionally occur in this country," replied her mother, "so that you have some chance of feeling one ; and in the southern parts of Europe they are very common.

"On the coast of Chili, in South America, earthquakes are so frequent and so violent, that the town of Conception, the capital of that country, has been repeatedly destroyed by them. Their frequency may be judged of from the statement of Captain Bagnold, (who resided for some time at Coquimbo on the Chilian coast,) which is, that sixty-one earthquakes happened during the brief space of a year, not counting slight shocks, which were still more numerous. The last time Conception was rebuilt, the inhabitants, knowing that it could never withstand the earthquakes, determined to reconstruct it in such a manner, that they should receive the least possible injury from its demolition."

"Then," said Edward, "they built it up for the purpose of being thrown down; I think it would have been wiser to have built it in some safer place."

"That would be very difficult," replied Mrs. B., "for the whole of the surrounding country is subject to earthquakes. Besides, people naturally attach themselves to a spot in which they have always resided; the inhabitants of some cultivated grounds on the slope of Mount Vesuvius, which had been completely covered by the lava, were offered, by the King of Naples, an equal quantity of ground in any other part of his dominions; but they rejected this offer, and preferred remaining where they were, though their property was ruined.

"The inhabitants of districts subject to earthquakes become, as it were, so familiarized to them by the frequency of their occurrence, that the anticipation of them fails to strike the people with great terror, or to produce in their minds that dread which we should feel, who know by experience so little about these convulsions of Nature. This difference is admirably depicted by the celebrated Humboldt, who devoted many years to scientific investigations and inquiries, in various parts of America, as well as of Europe. 'From our infancy,' he says, 'the idea of certain contrasts fixes itself in our mind; water appears to us an element that moves—earth a motionless and inert mass. These ideas are the effects of daily experience; they are connected with every

thing that is transmitted to us by the senses. When a shock is felt, when the earth is shaken on its old foundations, which we had deemed so stable, one instant is sufficient to destroy long illusions. It is like awakening from a dream; but a painful awakening. We feel that we have been deceived by the apparent calm of Nature—we become attentive to the least noise—we distrust, for the first time, a soil on which we had so long placed our feet with confidence.

"'If the shocks be repeated, if they become frequent during succeeding days, the uncertainty quickly disappears. In 1784, the inhabitants of Mexico were as accustomed to hear the thunders roll beneath their feet, that is, to hear the rumblings of the earthquake under ground, as we are to witness the vivid flash in the region of the clouds. Confidence easily springs up in the human mind; and we end by accustoming ourselves, on the coast of Peru, to the undulations of the ground, like the sailor to the tossing of the ship caused by the motion of the waves.'

"But to return to Chili. There was an earthquake on the 19th of November, in the year 1822, the shock of which was felt at the distance of fourteen hundred miles; and above a hundred miles of the coast was found to have been heaved up between three and four feet, within the short space of twenty-four hours. For the first account of this singular fact, we are indebted to a very intelligent lady, Mrs. Maria Grahame. In the course of her investigations, she satisfactorily as-

certained that the coast had in former times been elevated by the same cause, at least fifty feet.

"The last time the town of Conception was destroyed, was as late as February, 1835, when the adjacent coast, to the extent of six hundred miles, was elevated five feet by the shock; and an island in the bay rose ten feet, leaving the shell-fish on the rocks to die for want of water."

"How long does an earthquake last?" inquired Caroline.

"Seldom more than a minute at a time; but repeated shocks sometimes occur at very short intervals. Lisbon, near the time of the great earthquake, is said to have been agitated more or less for about a year. They vary much both in frequency and violence. The agitation is sometimes so weak that it is only sensible to those who are accustomed to such phenomena; or it may have no other effect than that of shaking the bells and the loose articles of furniture: but at other times the earth reels like a drunkard, as though moved from the balance which had been assigned to it by its Creator—cities are overturned, districts are laid waste, and the entire aspect of a country is instantly changed—mountains are overthrown, rivers are turned from their courses, and lakes are swallowed by the greedy earth. The shock which is supposed to have done most if not all of the damage at Lisbon, of which I have already spoken, lasted but the *tenth part of a minute!*"

"What an awful thing!" exclaimed William.

"Only think, in the short space of *six* seconds, which is less time than I have now been speaking, thousands and thousands of human beings, full of life and health, were suddenly cut off in the midst of their career, and some of the proudest and noblest of man's works were crumbled into dust!"

"Truly awful is the thought of it, and this should serve as another warning to us," observed Mrs. B. "to have our house always in order, and to be at all times prepared for the summons which sooner or later will call us from this world, to the world of spirits."

"What is the manner of building that the Chilians have adopted?" asked William.

"They build the whole of their houses on the ground floor, so that if the house fall, those only within it can suffer."

"Then, of course," said Sophy, "they take care to run out, as soon as they feel the slightest shock."

"No doubt; they walk up and down the middle of the streets, which are purposely very wide, and think so little of danger, that a gentleman who had witnessed the spectacle assured me, that, to see the whole of the inhabitants of the town parading the streets in their night-gowns, on a beautiful moonlight night in a warm climate, wore more the appearance of a public show than of a turn-out on account of an alarm: thus they remained till the shocks were over."

"Yet still there was danger of their houses *being* destroyed, though their lives might be *safe*?"

"Earthquakes occur so frequently in that country," resumed her mother, "while those of sufficient violence to destroy the town are comparatively so rare, that the inhabitants, when they feel the usual shocks, entertain very little idea of danger."

"Well," said William, "I do not know which is worse, the eruption of a volcano, or an earthquake."

"I would certainly prefer an eruption," observed Edward, "for in that case I should know, at least, from what to fly; whilst in the case of an earthquake, you can find no shelter."

"You must not seek for shelter from an earthquake," said his mother, "but fly to the open fields, and there you will be in safety; unless indeed a chasm should open beneath your feet, but that is of very rare occurrence. The city of Naples, though it has never been injured by the direct effects of eruptions of Vesuvius, has suffered severely from the earthquakes accompanying them. In the year 1805, an earthquake rent the walls of many buildings in Naples; and a nobleman who inhabited a magnificent palace there fell through a chasm in a floor opened by the earthquake.

"The most tremendous of all natural calamities," continued Mrs. B., "is when the eruption of a volcano is accompanied by earthquakes, the subterranean fires shaking the ground previous to their finding vent. The most dreadful eruption of this nature I ever heard of was from the volcano of Tombaro, in the island of Sumbawa.

The sound of the explosion was heard at Sumatra, one thousand miles distant. It was accompanied by earthquakes and whirlwinds, which not only tore up the trees by their roots, but carried up men and cattle into the air. Several streams of lava burst from the crater, and so great was the eruption of ashes that they were dispersed to the distance of three or four hundred miles. Another volcanic eruption on nearly the same vast scale occurred in the year 1772, in the neighboring island of Java, when the lofty volcano of Papandayang burst forth with terrific violence. An extent of ground fifteen miles long and six broad was swallowed up, the cone of the mountain falling in, by which its height was reduced from nine thousand to about five thousand feet: forty villages were destroyed, and nearly three thousand persons perished. But, as respects the destruction of human life, many earthquakes have committed more appalling ravages than this. The earthquake at Lima, in 1746, destroyed three quarters of the city and one hundred and twenty thousand of its inhabitants. At a far earlier period, history tells us of a still more mournful occurrence. The earthquake at Antioch, on the 20th May, in the year 520, buried among the ruins of the buildings two hundred and fifty thousand persons. But you have had enough of dismal stories for to-day."

"Before you go, mother," said Edward, "I should like to hear the *particulars* of some more recent earthquake, if you will be so kind as to *indulge* my wish. I saw, not long since, an allu-

sion to a terrible earthquake which happened at Aleppo in 1822, when thirty thousand persons lost their lives, and the reader was referred to the letter of Mr. Baker for an account of it. Did you ever see it?"

"Yes; the letter was addressed to the British and Foreign Bible Society, and is in a book now before me. It is as follows. 'On the night of the 13th of August, about half past nine o'clock, Aleppo, the third city of the Ottoman Empire, built entirely of stone, was, in the space of a few seconds, brought down to its foundation. I was, at the time, asleep on the terrace of my particular friend, Mr. Meseyk, who, by the help of the Almighty, was mercifully saved, with all his family. About half an hour previous to the great shock, a light one was felt, when I took the precaution to draw my bed from under a very high wall, where it was placed. I was soon awakened by the fall of that wall, on the very spot where my bed had stood. I sprang from my couch, and, without waiting to dress myself, I fled into the house, which I found falling on all sides. To remain in the house, or to take flight through the streets, appeared at first equally dangerous: at length, I embraced the latter resolution. In consequence, I descended the back stairs of Mr. Meseyk's house, for the great staircase fell at the same time. The darkness of the night, and the clouds of dust that covered the atmosphere, prevented me from perceiving the stones and rubbish on the stairs which had fallen from part

of the house, and consequently I was precipitated into the court-yard, and on a dead body. How can I express my feelings at that moment, ignorant on what body I had fallen? I was half dead with fright and horror. I afterwards learned it was a faithful servant, who had a second before descended those stairs, when some stones from an adjoining Turkish house fell on him and killed him.

"'I quitted that melancholy spot, and, like a man deprived of his senses, ran amid the fallen walls to the gate of the town, which is situated at some distance from my friend's house. It was on my road, among narrow streets, that I was destined to witness the most horrible of all scenes. The light of the houses whose sides had fallen exposed to my view men and women clinging to the ruined walls of their houses, holding their children in their trembling arms; mangled bodies lying under my feet; and piercing cries of half-buried people assailing my ears—Christians, Jews, and Turks.

"'After a great deal of trouble and fatigue, running among the ruins, I arrived, exhausted, at the gate of the city called Babelfarnige, the earthquake still continuing. But the gate of the city was shut, and no one dared to risk his life under its arch to open it. I threw myself on the gate. I felt in the dark, and perceived it was not locked, but the great iron bars that went across the folding-doors were bent by the earthquake, and the little strength I retained was not sufficient to force *them*. I went in quest of the guards, but they

were no more. I fell again on my knees before the Almighty, and while in that attitude four or five Turks came near me, and joined hands to pray in their accustomed way, calling out "Allah! Allah!" Having in sight my safety, and that of thousands of individuals who crowded to the gate to escape, I made no more reflections, but began to entreat them to help me to open the gate in order to save our lives. Providing themselves with large stones, in a little time they forced the bars and opened the gate. No sooner had I quitted it than a strong shock of an earthquake crumbled it to pieces, and several Jews were killed by its fall. When I recovered a little my senses, I began to feel new sufferings in the thoughts of what had happened to my brother and his family at Antioch, and the cruel fate of my friends in the city; besides, the melancholy objects around me—people wounded, others lamenting the death of their relations, others having before them their dying children taken from under the ruins—preyed so strongly on my mind, that not the pen of the ablest writer could give an adequate idea of my feelings.'"

"How thankful I am," exclaimed Cary, "that we do not live at Aleppo."

"Nor Lisbon," said Sophy.

"Nor in Chili," continued William.

"Nor in any section of the world," added Edward, "where such dreadful convulsions of Nature are so liable to occur."

"I cannot better close our conversation," re-

marked Mrs. B., "than in the following words of another. 'A number of painful reflections rush into the mind when we consider the influence of some phenomena in the destruction of human life, and we turn with fear from the picture of the past, mistrusting the condition of the physical agents by which we are surrounded. In the bright morning of expectation we fancied that all without, as well as within us, could have no other influence than the production of pleasing emotions and happy associations. We first learn that there are as many sources of misery as of pleasure in our own minds, and man and Nature then assure us there is no real dependence on them. The morning may be placid, and the unclouded sun may deck in its chastening hue the face of Nature, but it may set enveloped in clouds, amid the strife and the discords of Nature. Curiosity and dissatisfaction might prompt the inquiry, Why has the Creator of all things permitted the existence of causes calculated to destroy animal life? but if religion and reason reply, they answer, that man may feel his dependence upon Him who has all agents under his control, and has so ordered them as to secure, consistently with the nature of his terrestrial government, the accomplishment of his own will, and the happiness of the greater number of his creatures.'"

CONVERSATION TWENTY-SECOND.

ACCOUNT OF SANDY DESERTS.—WELLS.—CARAVANS.—CAMELS.—SIMOOM.—ARABS.—STEPPES.—PAMPAS.

"WELL, mamma," said William, "I hope you have some more terrible stories to tell us to-day."

"Not on volcanoes and earthquakes, at least," said his mother; "to-day, I mean to give you some account of those immense plains of loose sand which are to be found in Asia and Africa, and they will furnish us with some interesting anecdotes. In the north of Africa, these deserts extend from the Western Ocean, across the continent, as far as Egypt, leaving only a border of vegetation on the northern coast."

"And are there no means of cultivating these plains?" asked William.

"Were the neighboring districts inhabited by civilized people, some progress in cultivation would probably be made; but, surrounded as they are by barbarous tribes, there is little chance of it; for it is more difficult to create a soil on such loose sands, than on a barren rock."

"I wonder at that," said Edward; "I should have thought that seeds would much more easily take root on sand, than on lava, or a hard rock; for the roots would penetrate between the sand, and be better supported than on a barren rock."

"They might be rather better supported," replied his mother, "but not so well fed. They could not germinate, for want of water; for, on a level plain, there are neither hills, nor mountains, nor rivulets, nor rivers."

"To be sure," said Edward, "there can be neither rivulets running down the hills outside, nor gushing from inside; for, when it rains, the water will flow straight down through the sand, (as it did in our filter,) till it gets to the bottom."

"But when it reaches the bottom of the sand," said William, "it may, perhaps, meet with some clay, or rock, or cavern, where it may collect, and make a reservoir."

"That may happen," replied his mother; "but the water cannot rise thence to the surface of the ground. A spring which comes from reservoirs in hills and mountains flows from an elevated spot, and descends to the place whence it gushes out of the ground. It is impossible for the spring to be higher than the reservoir; so that, if the reservoir is situated beneath the level of a plain, it can never ascend to the surface of that plain; and this is the principal reason that plants cannot grow in these sandy plains, and that they remain, from age to age, a desert wilderness."

"I should have thought," said Sophy, "that the rain alone would have been sufficient to produce some sort of vegetation."

"It would, if the soil were of a nature to retain the water some time near the surface of the ground, *within* reach of the roots of the plant; but the rain

runs straight through this loose sand, so that, if any seeds had germinated during the wet season, they would be parched and destroyed by the sun, when the dry weather returned."

"But," said Edward, "if there are reservoirs of water under ground, could they not dig wells, and raise the water in buckets?"

"They do so," replied his mother; "but the water thus procured, far from producing a sufficiency to feed vegetation, is scarcely enough to supply the wants of travellers, who are often reduced to the greatest distress, and sometimes perish, for want of water. For, besides these wells being frequently at a great distance from each other, the water is sometimes so brackish as not to be drinkable, as these deserts abound in salt."

"They must be produced by salt-mines, then," said William; "for there are no rivers running into them, to supply them with salt, as they do the sea."

"But perhaps there may have been, once," replied Mrs. B. "We know not what was the origin of these deserts; and it is thought by some learned men that, many centuries ago, they may have been covered by the sea; and that, owing to some violent convulsion of Nature, the sea may have receded from them, and left them dry."

"How curious!" exclaimed Sophy; "then these desert sands are, perhaps, the bottom of what was once a large sea?"

"But," said Cary, "if there are no towns and

no inns, at the bottom of this dry sea, where can travellers dine and sleep ?"

"People do not travel there in the same way as they do here, my dear : they set out, a great number together, with tents, which they pitch at night to sleep in, and an ample store of provisions, and of water, contained in skins, the whole of which is carried on the backs of camels. Nature, which has not fitted such countries to be inhabited, has at least supplied mankind with the power of crossing them, by means of these patient and laborious animals. They are adapted by Nature to contend with the difficulties they have to encounter in these desolate regions. They are not only excellent beasts of burden, carrying each six or seven hundred weight, but they can drink at one time as much water as will satisfy them for ten days ; and they can eat a sufficient quantity of food before setting out to require but little on the road ; during the journey, I should say, for there are no roads on these loose and movable sands."

"Then I wonder travellers do not lose their way," said Edward, "since they can have nothing to guide them ?"

"There are always guides with them, who find their way, by the help of the sun or moon and stars, from one well to another, and these wells are generally their resting-places where they pitch their tents. A party thus travelling is called a caravan, and consists of several hundred persons, with perhaps a still greater number of camels."

"And are there no carriages?" asked Cary.

"No; carriages could not make their way without roads."

"I wonder so many people should like to travel in such a country," said Sophy.

"I do not think there are many who travel for mere pleasure," said Mrs. B.; "some few are led by curiosity to visit such countries, but the caravan consists chiefly of merchants, who carry their goods from one country to another for sale; much in the same manner as in the days of Joseph."

"And was it into one of these dry wells that Joseph was thrown, mamma?" said Sophy.

"Yes; and you may remember in Scripture that after his brethren had cast him into the pit, it is said, they beheld a company of Ishmaelites coming from Gilead, 'with their camels bearing spicery, and balm, and myrrh, going to carry it down to Egypt;' and in the present day, the caravans of Egypt and Arabia are carrying on the same trade which they did in the patriarchal days, and in the same manner. There are now, also, a great number of Mohammedan pilgrims who traverse the deserts of Arabia to visit the temple of their Prophet at Mecca."

"Well," said Sophy, "I think I should feel safe at least with so large a party of travellers."

"It is, however, always a dangerous journey," replied her mother. "There are often in these deserts sudden gusts of noxious winds called the Simoom, which in a few moments fill the air with

sand, so as to render it impossible to breathe; and the only means travellers have to prevent being choked by the sand, is to throw themselves down with their faces to the earth, holding them close to the ground, in order to prevent the sand in the air from getting into their mouths: thus they remain till the gust is over, and if it lasts long, many are suffocated for want of air to breathe. Another bad effect of the Simoom is to dry up the water in the skins, and it sometimes happens that a great part of the contents of a full water-skin will be evaporated in a morning. In such cases, if they are far from a well, and no water is left, to preserve their lives, they are obliged to kill their camels, to obtain the store which these animals carry in a sort of reservoir in their stomachs."

"O the poor camels!" cried Sophy, "after being so very useful to them. It would be cruel, indeed, if it was not to save the men's lives."

"They have, besides, another source of danger," continued Mrs. B., "from the wild Arabs who inhabit the neighborhood of these deserts, and who frequently attack the caravans, and carry away the merchandise and camels, leaving those who escape with their lives, in a state of utter distress."

"I thought, mamma," said William, "that the Arabs were a very kind, hospitable people, who lived in tents, and were wholly taken up with the care of their cattle."

"It is true," replied his mother, "that if once

an Arab has received any man into his tent, he will not only feed and lodge him, but will defend him at the risk of his life. But many of their tribes are very warlike, and think they have a right to attack the caravans who come into their Country as much as if they were enemies who came with hostile intentions."

"I remember," said William, "reading in the life of Alexander the Great, of his crossing the great desert of Libya to visit the temple of Jupiter Ammon, and of the great hardships he had to undergo in that expedition."

"That," replied Mrs. B., "is the large desert in the north of Africa, and is now called the Desert of Sahara," and she showed it to her children on the map of Africa; "it contains no less than 200,000 square miles."

"Indeed!" exclaimed the children; "how immense!"

"But," added Edward, "how could a fine temple be built in such a desert?"

"There are several spots in these deserts where there are hills and valleys, and consequently springs and rivers, and the soil produces an abundant vegetation. These fortunate spots, called *Oases*, are sometimes of considerable extent, and look like islands situated in an ocean of sand; it is on one of these that the Temple of Jupiter is built."

"These must have been real islands rising above the sea, when this desert was covered with water," said William.

"Probably," replied his mother; "if, indeed, these deserts were ever covered by the sea; but though such has been supposed to be their origin, we have no certain knowledge of it."

"How glad the caravans must be when they reach one of these islands," said Sophy; "after such a length of barren sand, the vegetation must look like a paradise, and then I suppose they are inhabited."

"Yes," replied Mrs. B.; "travellers describe their arrival at these spots, the cheerful singing of the birds, the sweet smell of the plants, and the preparations for their reception by the inhabitants who have been expecting a caravan, as creating such intense delight, that it in some measure compensates for all the hardships of the desert."

"Mamma," said William, "supposing these flat plains consisted of a good soil instead of loose sand, would they still be barren for want of running water?"

"No," replied she; "for the rain, instead of filtering through as it does in sand, would remain some time in the soil, and would supply nourishment to various sorts of grasses; but would not afford sufficient moisture for the vegetation of shrubs and trees. There are many very extensive plains of this description, called *steppes*, in Asia and America, and also in Russia towards the confines of Asia. The grass shoots up in the rainy season of spring, with prodigious luxuriance, and grows often to several feet in height;

it is enamelled with a great variety of beautiful flowers, and large droves of cattle or flocks of sheep find an abundant pasture when the rainy season is over, there being no streams to water the soil. When these steppes are situated in a warm climate, this beautiful vegetation is destroyed by the scorching heat of the sun in summer. The flocks and herds are then driven northward to a cooler climate, where the grass is not burnt up, and in winter are brought back to the southern districts, where the autumnal rains have produced fresh pastures."

"How immensely large these plains must be," said Edward, "to have such a variety of climate!"

"They are, indeed," replied his mother; "the Pampas of Buenos Ayres, in South America, which are plains of this description, reach across the continent, and extend northward to a tropical vegetation of palm-trees; while, southward, they are bounded by the eternal snows of the south pole: so, you see, there is a sufficient diversity of climate to suit the pastures at different seasons of the year."

"And are there no towns in these Pampas?" inquired Sophy.

"No; it would be impossible either to build, or to inhabit towns, in a country deprived both of wood and water. The drovers and shepherds, who almost live on horseback, are always travelling about with their flocks and herds in search of the best pastures: they catch what water they

can when it rains, and preserve it in skins ; and as for fuel, they have nothing but dry grass. In the Pampas, I have heard that they use the flesh of their cattle for fuel to melt the fat which they export to Europe for tallow."

"How very strange !" said Sophy ; "do they not want the meat to eat ?"

"O, no ! the cattle multiply so fast in these rich pastures, and the inhabitants are so scarce, that they have much more meat than they can consume, so that it is no loss to them to use it for firing."

"And is there no corn to make bread in these steppes ?" asked Caroline.

"No ; the drovers are obliged to live wholly on animal food ; and in order to give the meat some resemblance to bread, they bake it quite dry, and then pound it and make a sort of paste with the flour."

CONVERSATION TWENTY-THIRD.

ON THE NATURAL FORMATION OF SOIL, ON A BARREN ROCK.—OF THE NUTRITIVE PART OF SOIL DERIVED FROM DEAD VEGETABLES.—OF THE USE OF THE EARTH IN SOIL, TO SUPPORT PLANTS AND RETAIN WATER.

"MAMMA," said Sophy, "I have been thinking about the beautiful plants that grow on Monte Nuovo, and I cannot conceive how they got there; for, though the lava may have been cool for hundreds of years, still it is only hard dry lava; there is no ground or soil on it fit for plants to grow in, and how can it begin? for I know that a soil does not grow as plants do."

"It is a matter of much difficulty," said Mrs. B.; "it requires a great length of time for Nature to produce a soil either on lava or naked rock; but you know that Nature never grows old and dies, so she has plenty of time to work in, and therefore is in no hurry."

"Well, but how does she set about it?"

"In order to make a soil fit for plants to grow in, there must be some dead vegetables rotted to pieces and mixed with the earth; it is this which supplies food for the living plants. The dark mould in the kitchen-garden consists almost entirely of the remains of dead vegetables."

"But there must be living vegetables before there can be dead ones," said Sophy, "and there were none upon Monte Nuovo."

"True," replied Mrs. B.; "there is a species of plant called lichens or mosses."

"Do you mean like the moss with which we cover the tops of flower-pots, mamma, to hide the mould?"

"That is one kind of moss; but the moss I am speaking of is much smaller, and resembles rather the gray moss that grows on the stems of many fruit-trees: it is so small, that it looks more as if the tree were discolored by some disease, than as if any vegetation was forming upon it. The seeds of lichens are so small as to be invisible, and so light as to float in the air, and be borne about by the wind; and thus they are transported to great distances from the spot where they grew. Now, let us suppose that some of these seeds, carried off by the wind, were cast upon a hard naked rock, what do you think would become of them?"

"Since there would be no soil for them to grow in," said Edward, "I suppose the sun would parch them up, or the rain would wash them away, or the wind would blow them off the rock."

"Nature," replied his mother, "who takes care even of the invisible seeds of lichens, has so formed them, that they are glutinous on the outside, so that they adhere to the spot on which they fall, and are not very easily either blown or washed away; then, if they happen to fall in a *crack*, fissure, or crevice of the rock, they would

be more or less sheltered from the sun, and the wind, and the rain."

"But not from the rain after it has fallen on the ground," said Sophy, "for it always dribbles down little cracks and crevices, and sooner or later would wash the poor little seed away."

"And where would it carry it, Sophy?" said her mother; "to a lower part of the rock, and in its descent it would probably meet with some little nook or corner, which would serve as a resting-place; and, being thoroughly soaked with water, it would then swell and germinate, or begin to grow."

"Grow? without any ground to grow in, mamma?" asked Sophy.

"Don't you know that hyacinths grow in water without any ground?" said William; "and I am sure they must be a hundred times larger than lichens."

"Yes, but they are supported by the glasses in which they grow," said Sophy.

"Lichens are so small and so low," replied her mother, "that they have no length of stems to require support. Besides, they are furnished with means of clinging to the dry rock, either by claws which grow into the rock, or tendrils like the vine."

"How good Nature is to take so much care of these poor little plants," exclaimed Sophy.

"It is not surprising," replied her mother, "if you consider that Nature means the laws which a perfectly good and Almighty God has established

for the preservation of all his creatures. His care is not confined to men and animals, but descends to the lowest amongst created beings, of which the lichen affords a striking example. But, small and insignificant as these plants appear, they are, you will find, of great importance in affording the means of forming a soil where none exists ; a soil in which, in after ages, the venerable oak may rear its stately head."

"It reminds me, mamma," said Caroline, "of the grass which you told us supported the mountains. Is it not wonderful that such tiny plants as lichens and grasses should be able to do such great things ?"

"Nothing is little or insignificant in the creation, my dear," said her mother ; "when you are old enough to understand it, you will find that great and small work together for the good of the creation and the glory of God ; and there is not a drop of rain that falls to the ground, nor a breath of wind that wafts the air, which has not its appointed time and place to work for the general good. Let us see how the lichen performs its task in this great system of the universe.

"Though the first seeds which light on the rock might grow," continued Mrs. B., "they would grow but in a very imperfect manner ; for the poor little roots, being fixed to the rock merely by clinging to it, without soil to cover them, would wither ; and the plant having no other food than water, its life would be so sickly that it would die *without* leaving any seed, or, at least, any that was

ripe and fit to produce a new plant; so that there would be no young lichens to succeed it."

"O! poor dear little lichen!" said Sophy; "then it is of no use after all, if it is to die and leave nothing behind it?"

"Yes," said William, "it will leave its ashes after it is dead, and that will be a first beginning of good vegetable mould."

"But what a beginning!" cried Sophy; "I dare say the dead lichen, when it is rotted to pieces, will not make more mould than a pinch of snuff."

"Nor nearly so much," replied Mrs. B.; "probably not more than a grain of sand, but still that little is better than nothing; and the next seed of lichen which happens to fall on that spot, will find both a little soil to grow in, and a little food, which the rain-water will dissolve and carry to its roots; and if it has not strength to ripen its seeds, it will at least double the quantity of vegetable soil after its death."

"Then, I dare say," said Sophy, "there will be soil enough for the next seeds that are brought by the wind, to grow strong and hearty, and leave plenty of seed and sow them in the new mould."

"Possibly," replied her mother; "if not, it is only waiting a year or two longer to form the soil more completely."

"Well," said William, "but suppose this rock or lava, on which you are forming a soil, to be very far distant from any land, no seeds can ever reach it, but such as are light enough to be wafted by the air."

"The air will support and convey seeds much larger than those of lichens," said his mother; "and supposing the rock to be standing insulated in the midst of the sea, seeds are often conveyed by the sea itself, floating on the surface of the waves, and may be cast ashore on this rock. The Indian seeds are often drifted on the western islands of Scotland by the current of the ocean, and even a canoe was brought to one of these islands some years ago. Sometimes, they are brought by birds of passage, which will be glad, in their long flights from one Country to another, to find a resting-place on this rock, barren as it is, and on their departure, may possibly leave some seeds behind; and thus, a naked rock might, in the course of ages, be clothed with vegetation by some such chances. But the formation of soil on Monte Nuovo is much more easy, for it is surrounded by a country covered with vegetation; so that there could be no difficulty in finding seeds of various sorts when the soil was ready to receive them."

"And is the soil on Monte Nuovo all made of dead vegetables?" asked Sophy.

"The nutritive part is; but the lava has also crumbled down and mixed with it; and this is the case also in the formation of a soil on a barren rock: if the rock is composed of chalk or limestone it easily crumbles, but if of flint or sandstone it is of a harder nature, and a soil is much longer in being formed from it."

"But," said Sophy, "if it is only vegetable

mould that nourishes plants, of what use is any thing else in the soil? the plants might thrive just as well without any earth."

"The earth serves to support the plants," replied her mother; "and for this purpose it is necessary that the earthy part of the soil should be much larger in quantity than the vegetable part. Creeping plants, and lichens, which are furnished with various means of clinging and sticking to walls and rocks, do not require much soil; but trees and shrubs cannot do without earth to support them, and prevent their being blown down by the wind. It is therefore necessary that the nutritive part of the soil should be mixed with a considerable quantity of earth, in which the roots of plants may be firmly lodged without danger of being disturbed by storms."

"O, yes!" cried Sophy, "the earth is the lodging in which they live, and the decayed vegetables are the food that nourishes them."

"Exactly so," said her mother. "Now the soil in which they lodge is made of different kinds of earth, as the houses in which we live are constructed of various kinds of materials."

"O! but, mamma," said Sophy, "it is only poor people who live in mud cottages; our houses are built of brick or stone."

"True," replied her mother; "but brick and stone both consist of earth; brick is made of one kind of earth, and stones of a mixture of several earths. Then brick is made by man, and stones by Nature; the first is an artificial production, *the other* a natural one."

"I know that bricks are made of clay," said William, "put into moulds and afterwards burnt, or rather baked in the kiln."

"And stones," continued Mrs. B., "generally consist of a variety of earths, and often contain some particles of metal besides. So you see that the houses of the rich as well as the mud cottages of the poor are made of earth."

"But earth," said Caroline, "is more like crumbled powder, not hard like a stone."

"Earth," replied her mother, "has a variety of states. It is sometimes hard, and in large masses, as in rocks; sometimes spread out on the surface of the ground in a soft state, as in clay; sometimes finely pulverized, as in sand; and you have seen that the white earth, lime, can be dissolved by water so as to become invisible. Lime, when it is in the state of rock or stone, is called limestone, and sand forms sandstone."

"Well," said Sophy, "I own I thought there was only one kind of earth, and that was the ground."

"But, my dear, there is a great variety of earths in the ground we tread on: the principal of these are clay, sand, and lime, mixed together; they form soils, and it depends upon the proportions in which they are mixed, whether the soil be good or bad for vegetation."

"But," said Edward, "since it is the vegetable part of the soil alone that nourishes plants, how can the different earths do them either good or harm? If there is sufficient soil to support *them*, it must signify little of what it is made."

"There you are mistaken," said his mother. "If the soil consist chiefly of loose sand, in the first place the roots of the plant will not be firmly supported; and, in the next place, the water will filter through the soil so quickly that the roots will not have time to take up nourishment to feed the plant; so it will both be ill fed and in great danger of being blown down."

"Then clay must make an excellent soil," said Sophy; "for that will keep the water long enough for the roots of plants to suck up as much as ever they want."

"And more than they want," replied her mother; "plants often become swollen, and grow dropsical, from drinking too much."

The children laughed heartily at the idea of plants becoming dropsical.

"But, mamma," said Sophy, "if there is plenty of vegetable mould mixed with the clay, the water will only melt more food and make the plant grow faster."

"Plants may over-feed, as well as over-drink themselves," said Mrs. B.

"O! but, mamma, you forget that they have no taste, so they cannot love sweet things as we do, and be tempted to eat too much."

"When they are gluttons," replied her mother, "it is only from necessity; a plant, though alive, cannot, like us, either know or choose between good and evil. The roots suck up all the fluid that comes within their reach, and they sometimes do so till they kill themselves."

"It is very hard for the poor plants to be punished for what they cannot help!"

"Observe, Sophy," said her mother, "that if from want of feeling they do not enjoy life, neither do they suffer when they die; therefore death is no punishment to them."

"Then," said Edward, "a wet clay soil is as bad for plants as a dry sandy one? But if the two are mixed together it will just do."

"It will do much better," said his mother; "a mixture of sand and clay forms a sort of gravelly soil, and there is generally more or less lime mixed in the soil, which serves to lighten it.

"The earths," continued Mrs. B., "vary almost as much in color as in consistency. When chalky, and abounding with limestone, the soil is whitish."

"O yes!" said Edward; "don't you remember, William, when we went to see the lime-kiln, how white all the ground was; not only just by the kiln, but the soil of all the fields near it?"

"When," continued Mrs. B., "the soil consists chiefly of clay, it is sticky, and of a yellow, gray, or red color, according to the peculiar state of the iron it always contains."

"Indeed," said Sophy, "I know very well how sticky clay is: I can scarcely walk through the corn-field after it is ploughed; it sticks to my feet in such great lumps, it almost nails me to the ground; and then, if it has rained, it is all muddy."

"When the soil is impregnated with ochres,"

said Mrs. B., "it becomes red or yellow according to the color of the ochre."

"Just as the rivers are tinged with the color of ochres," said William.

"Yes," replied his mother. "There are several other earths which I have not mentioned; it will be time enough for you to know them when you are older."

CONVERSATION TWENTY-FOURTH.

THE SAND OF THE SEA.—CORAL REEFS.—TRIPOLI EARTHS.—DIFFERENCE BETWEEN ANIMALS, VEGETABLES, AND MINERALS.—ACCOUNT OF STONES.—ADVENTURES OF A STONE.

"PRAY, mamma," said Sophy, "is the sand at the bottom of the sea made of earth?"

"Yes," replied her mother; "that which you see on the shore is made from pebbles which have been pulverized, or reduced to a sort of coarse powder, by the action of the waves, which are continually beating and bruising them against each other and against the shore till they are at length broken to pieces, and finally reduced to sand."

"I suppose it is made from the large round stones which lie on the sea-shore?" said William.

"Yes," said his mother, "from those at least which are below the water, for those that are beyond the reach of the waves cannot be affected by them."

"Yes," said Caroline, "the sands are under the water, and we can only walk upon them when the tide is low; whilst the large stones are only partly under water. But when we went out to the pleasant little fishing village of Sciasconsett, during our stay at Nantucket last summer, I no-

ticed there were no large stones at all ; the whole of the shore was sand, above the water as well as below it."

"The soil there is of a crumbling nature," said her mother, "and falls from the adjacent banks in the form of sand. There are, on the other hand, many coasts where the shore consists entirely of stone, either rock or pebble. This is the case in many parts of the Mediterranean, and it is owing to the tranquillity of that sea, which has no tides, and is less affected by storms, so that the stones are not exposed to very rough treatment. But the bottom of the sea does not consist wholly of sand ; this substance is intermixed with rocks, with immense beds of shells, and sometimes with mud. In warm climates it abounds with reefs or rocks of coral."

"Of coral, such as your necklace is made of, mamma ?" asked Caroline.

"It is of the same nature ; but my necklace, being cut into beads and polished, looks very different. These rocks are often many hundred miles in extent, and are remarkable for being the work of animals."

"Animals make rocks !" exclaimed Caroline ; "what large animals they must be, and for what purpose do they build them ?"

"To live in," replied her mother.

"But what sort of animals are they ? fishes do not live in houses."

"Shell-fish do," said Edward ; "at least I think the shell of an oyster or a mussel may be

called its house. Do you not call the shell of a snail its house, though it is not built like our houses ?"

"These coral reefs," said Mrs. B., "call them what you may, form the dwelling-place of the animals that build them, but instead of large powerful animals, they are extremely small, and of the lowest class in the order of animated nature. Indeed, it was for a long time doubted whether they were not plants."

"O, how was it possible," cried Sophy, "to mistake an animal for a plant, they are so unlike !"

"A naturalist," resumed Mrs. B. "once broke a branch of coral from the reef to which it belonged, and kept it in a vessel of sea-water taken from the same spot. On the following day, to his great surprise, he beheld the coral covered with, what he took to be, a number of small, white, star-shaped flowers, and he showed it to his friends as a curious specimen of coral in blossom. But no sooner were these blossoms exposed to the air than they faded away and disappeared, leaving behind no very agreeable perfume, for it was a smell of putrid fish; and on a further examination these apparent flowers were discovered to be small animals, which had come out of their coral cells to continue their work, but no sooner were they exposed to the air than they perished."

"O, poor little creatures !" said Caroline; "and with what do they build those coral rocks, mamma ?"

"They appear to have the power to secrete

and squeeze out of their bodies a sort of jelly, which hardens under water, and becomes a kind of limestone, and it is of this that the coral reefs are constructed."

"But since these little animals cannot live out of water, they cannot build above the surface of the sea," observed William.

"That is true," replied his mother; "the coral reefs are always under water, but often reaching so near the surface as to be dangerous to shipping."

"How very curious," said Sophy, "that such little creatures should build such large rocks, for you say they are immensely wide, though they do not rise above the sea; what a number of them there must be!"

"You can form no idea of the immense number or the minuteness of the various animalculæ existing in Nature," replied her mother. "There is a particular sort of earth called Tripoli, which from its hardness is used to polish metals. It has lately been discovered that this earth is composed entirely of the case or shell of insects, so small that hundreds of them might be contained in your thimble, Cary; and yet entire hills are formed of this curious species of earth."

"Then," observed Sophy, "Tripoli earth and coral are not minerals, but belong to the animal kingdom."

"No," replied her mother; "they are the work of animals, but formed of mineral materials."

"You would not call a house an animal because

it was built by a mason ; would you, Sophy ?" said her brother William, laughing.

" Indeed I should not," said Sophy, a little nettled at the remark ; " but mamma says the stuff the coral insects build with comes from their bodies, so that must be animal."

" That is not a necessary consequence," replied Mrs. B. " Indeed there is a species of bee called Mason Bees, from their building their cells with a sort of hard stone ; but it is as soft as putty when they first secrete it from their bodies. I have seen them sadly deface the front of a handsome stone house, by adding rows of stony cells to the walls. If these cells are discovered when recently made they may be easily removed ; but when once they are hardened it requires a hammer and chisel to dislodge them ; so that you must send for a man mason to get rid of the mason bees.

" Now where the mason bees or the coral insects get the material with which they work, I do not know ; but, though it is prepared within their bodies and secreted from them, it is of a mineral nature, like any other stone."

" Well !" cried Caroline, " I do think there must be more stones than any thing else in the world ; I have often wondered where they all came from ; the fields are full of them, and every time they are ploughed fresh stones are turned up. I take great pains, I am sure, to pick them out of my little garden, and yet I find new ones almost every day. They do not grow, do they ?"

"O no!" replied her mother; "nothing grows but what is alive."

"Yes," said Caroline; "alive like us, and birds, and beasts, and insects, and all sorts of animals."

"And nothing more?" said her mother, looking at her inquisitively.

"No!" said Caroline; "I know of nothing but animals that are alive and moving about."

"But are there not other things alive though they cannot move about?" said her mother.

"O yes! to be sure," cried Caroline; "only think of my forgetting my own little garden, and the beautiful flowers that I water so carefully to make them grow; and I know they could not grow without being alive; then they die! and nothing can die that has not been alive. A stone never died nor was ever alive."

"Plants," said Mrs. B., "are very inferior to animals, since they can neither feel, nor move of themselves; but they are living beings as well as we are, and are made with distinct parts, such as the roots, the stem, the leaves, the flower, and the seed; each of these distinct parts has a different office to perform."

"The roots, I know," said Caroline, "are made to suck up the water, and the stem carries it into the plant, to feed the leaves and flowers, and make the fruit grow; and then the seed of the fruit is to make new plants another year. As for the leaves and the flowers," added she, pausing to reflect, "I do not know

of what use they are, except to look pretty and to smell sweet."

"Even that would be of some importance," replied her mother, "when you consider how many people there are who enjoy the beauty and the perfume of flowers. But when you are older you will find that they also have their allotted duties to perform. Animals are also made with distinct parts, adapted to particular purposes; as the eyes to see with, the mouth and teeth to eat with, the veins and arteries to circulate the blood; all of these distinct parts, both in the animal and vegetable kingdom, are called organs; thus the eyes are the organs of sight, the ears of hearing, the stomach of digestion, and so on."

"Organs!" exclaimed Caroline, with wonder, for her imagination immediately led her to think of the organs she heard at church and those that are played about the streets; but her mother told her there was no connection or resemblance between them.

"Now," continued Mrs. B., "a stone has no organs, and therefore it could neither live nor grow; it belongs to the mineral kingdom, which comprehends all the earths and metals."

"To be sure," said Caroline, "stones cannot be fed; for they have neither mouths nor roots, to eat or drink with, nor have they seed to grow into other stones."

"But then they never die!" said Sophy; "and I am sure there is no need of new stones, there are too many already; I only wonder there

should be such a number, since they do not grow."

"I did not say they could not increase in number," replied her mother; "but only that they do not grow like organized beings, such as animals and vegetables; but stones increase every time fresh fragments of rock fall to the ground and are broken and worn into stones."

"And they diminish too," said William, "whenever stones are carried down to the sea, and there are turned into sand. So, though stones are minerals that can neither live nor die, there are new stones made and old ones destroyed."

"Yes," said his mother; "the mineral kingdom is constantly changing, as well as every other part of the creation."

"I should like very much to know the history of a stone," said Caroline, "if it could tell whence it came, and where it was going, and what had happened to it during its travels."

"We might, in some measure, guess what it would answer," said Mrs. B.

"I am sure we could not," replied the children; "but do, pray, tell us, mamma; make the stone speak and tell us its history."

Their mother laughed at the idea. "Indeed," said she, "I know neither the language nor the voice of a stone, but if it is only a pebble it cannot speak very loud." Then assuming a grave look, and mimicking a small voice, she began thus: "'The first thing I remember was that I made part of a large rock, at the top of a high mountain,

whence there was a most beautiful and extensive prospect of the country around; and I was particularly well placed to see it, as the part of the rock, in which I was, projected forward and overhung the adjacent valley. I had remained there very quietly some thousand years—'"

"O! mamma!" cried Edward, "does not the stone exaggerate?"

"I do not think so," replied Mrs. B.; "for rocks are very durable; but it is true it had no exact means of calculation."

"'Some seeds of lichen,' continued the stone, 'now and then fastened to me, and endeavored to grow; but I was so round and smooth, and projected so much into the air, that the rain ran off as fast as it fell on me, so the seeds could get no food, and were parched up by the sun. All at once the earth shook violently, the rocks reeled to and fro, and that to which I belonged was hurled down into the valley beneath, where it was broken into a thousand pieces.'"

"That must have been an earthquake," said Edward.

"Or some spring of water that had undermined the mountain, as at Goldau," said William.

"Or perhaps the bursting of a lake like that of Martigny," said Sophy.

"Indeed I don't know which it was," said Mrs. B.; "'but down came the rock with a violent crash, and I,' continued the stone, 'being one of the fragments, was cast on the ground with such force that I sank many feet deep into it, and was

completely buried. This was a dismal situation compared to that I had so long enjoyed. However, I comforted myself with the idea of being at least safe there, as I could not well fall lower. Then I was curious to see what was going on under ground. After a short time—'"

"Not above a hundred years, I dare say," said Edward, laughing; "that is but a short time for a stone."

"Perhaps not," replied his mother. "'I heard a gentle gurgling noise, and saw running by me a little rill of water; in the course of time it increased, and spread to the spot where I lay; at which I greatly rejoiced, for I longed for a thorough washing, having lain so long in the dirty ground—I, who had formerly been washed every day that it rained. Well; the water washed me, it is true, for it spread all over me, but instead of washing me clean, it seemed to make me dirty. O the deceitful stream! exclaimed I in my wrath, if it has not left its dirt upon me and cleansed itself; for as it flowed on, I observed that it was brighter and clearer than before.'"

"O! that is like the filter, you know, mamma," said Sophy; "and this is one of the rivulets under ground that makes a spring; but I wonder whether it was one of the little rills formed by the rain, as it dribbles through the ground, or whether it was a rivulet flowing from the reservoir to the surface of the earth, to gush out in a spring."

"No doubt the former," said Mrs. B.; "for the stone, continuing its history, says, 'I learned

that this rill, after leaving me, made its way deep into the earth, and passing over many valuable minerals, robbed them of some of their most precious ingredients. I therefore concluded that the rill was both a cheat and a thief; but, to my surprise, I heard that it proved in the end a most excellent doctor to mankind, and that with the salts, and metals, and other mineral substances which it had dissolved and carried off, in its way through the deep recesses of the earth, it cured more complaints than any doctor living!'"

"How could that be, mamma?" inquired Sophy.

"I suppose," replied her mother, "that when it came out of the ground it formed one of the famous mineral springs, such as those of Ballston or Saratoga, where, by bathing in or drinking the water, people are cured of several diseases.—'Well,' continued the stone, 'after having hung, as it were, in the air, during some thousand years, and been buried under ground some hundred, I was one day surprised by the sound of a grating noise above me, and I beheld a sharp instrument ploughing through the ground. It came so near me that I feared I should have been cut in two, doubting whether I was hard enough to turn the edge of such a large and powerful-looking weapon. However it did not touch me, but turning up the ground I was forcibly raised with it from my dark abode, and once more had the satisfaction of seeing day-light. I then found myself lying on the ground in an open field. It was amusing to look

about me after having been so long in the dark, and I was surprised to see how much I had changed whilst I had been buried under ground. I had fallen from the rock a rough, shapeless fragment, full of sharp points; these had been broken off as I was dashed to the ground, and the rill which had during so many years run over me had rounded and smoothed me, but I was greatly diminished in size. Still I was too large to please the laborers who the next day came with a harrow to level the field after ploughing, so they took me up, and cast me into the corner of the field, together with a number of other stones, and there we lay in a heap. I was not at all pleased with my situation; for, being one of the undermost of the heap, I could see nothing that was going on, and was grumbling at the idea that I might be thus imprisoned for a length of time. But my companions, who were better acquainted with mankind than I, (who had never seen them before I had been ploughed up,) assured me there was no danger of our remaining long in this situation, for that men were the most busy animals of the whole creation, and were never satisfied with letting things remain as they were so long as they thought they could change them for the better. So there is no chance of our remaining quiet since we have got into their power.

"'As my companions predicted, our situation soon changed, but, alas! it was for the worse, for shortly after we were carried away in a cart, and, sad to say, we were used to build the wall of a

house. There I was completely shut up, for not being handsome enough to make my appearance outside, I was enclosed with a number of other stones inside the wall ; and during the whole time I remained there, the only moving things I saw were a few rats and mice ; these increased as the house grew old, and luckily houses will not last for ever, so, after a couple of hundred years or so it fell to ruin, and one windy night, I, who had been so long imprisoned, had the satisfaction of rolling out of my dark dungeon. The house being built on a rising ground, I was cast down the slope, and fell into a river which flowed below. This was quite a new life for me. I lay tolerably quiet, in a bed of weeds, at the bottom of the stream; and watching the fish swimming above me and frolicking about so merrily, I thought they were the happiest animals in the creation.' "

"Except," said Sophy, "when the fishermen catch them in their nets ; but perhaps the stone never saw that."

"He saw what appeared much worse," said Mrs. B., "hundreds of small fishes swallowed up by one large one at a meal."

"'I thought this very shocking at first,' said the stone, 'but when in the course of time I saw a number of young fish come to supply their place, and frisk about with so much glee, I reflected that upon the whole there was no happiness lost, for had the fish lived to be old, they would have been diseased and infirm, and could not have enjoyed themselves as these young ones did, so that it was best as it was.' "

"But I should not think so," said Sophy, "if I was to be eaten up when I was old, to make room for younger people."

"If you were old," observed her mother, "you would in all probability be surrounded by your children and friends, who, by their tender care, would render your life happy, even amidst the sufferings and infirmities of age; and God Almighty, having provided such comforts for rational beings, suffers them to live to the end of their natural life, whilst other animals, that are incapable of feeling such tender sympathies, are on the whole happier not to live to be old."

"Then," said William, "lions and tigers, and all such wild beasts that devour each other, do good another way, for if they did not eat each other up there would be so many of them that they might perhaps eat us up."

"Very true," said his mother; "and observe of what use vultures, carrion crows, and such animals are, which feed on the dead carcasses of animals. If these carcasses remained to putrefy on the ground, they would not only produce a very offensive smell, but might breed pestilential diseases. Instead, therefore, of looking on such creatures with disgust, we should consider them as appointed to cleanse the earth of impurities."

"And I dare say, mamma," said Caroline, "that insects were made so fond of devouring the dead bodies of worms and snails, and all sorts of insects, for the same reason."

"They were made, I believe, first that they

might enjoy themselves," said Mrs. B., "and then that they might perform tasks which contribute to the welfare and enjoyment of others; for God loves all his creatures, and wills their happiness. Every living being therefore has his appointed office, in fulfilling which he works for the good of the whole.

"But to return to the hero of my tale: 'Though I was in general pretty quiet," continued the stone, 'yet when the river was swollen by heavy rains, and its current more rapid than usual, I felt myself dragged along with it.'"

"That is like the River Arno," said William.

"'It was pleasant enough to change my situation thus, and when the rapidity of the current abated I was again deposited in some nook at the bottom of the river. As I was thus gradually carried down the stream, I observed that it grew wider, and many of the fish were larger. At length, to my astonishment, the water became salt, and I was soon after cast upon a bank, whence I beheld the immense sea before me.'"

"That was a Delta at the mouth of the river," said William; "but pray, mamma, carry the pebble into the sea, and reduce it to grains of sand."

His mother then continued: "'I remained here a number of years, when one night, during a violent storm, I felt my old friend the river rushing like a torrent over me with prodigious violence, and again carrying me along with the stream; I was then plunged into the sea, where in the course

of a long period of years I was so beaten about and rubbed against the rocks by the waves, that I was broken into fragments, and these being broken still smaller, in some few years more, I was so triturated and pulverized that I was reduced to sand. And so there is an end of my tale.' "

"Well, I never could have imagined that the history of a stone, which seems such a stupid thing, could have been so amusing," said Sophy; "what a number of different things happens to it, above ground, and under ground, and under the water, and in the sea."

"And yet this is but the history of a common stone," said Mrs. B.; "if I had given you an account of a stone that had found its way into the subterranean fires, and been melted into lava, and thrown up by the crater of a volcano, and formed part of a new mountain, it would have made a much more wonderful tale; but I thought it more useful to you to learn the usual occurrences connected with the existence of a common stone."

TABLE OF THE

HEIGHTS OF MOUNTAINS.

ASIA.

No. in plate.	Mountain.	Height.	Place.
		Feet.	
1	Dhawalagiri, Dholagir, or White Mountain . .	26,462	Himmaleh Mountains.
1 to 6	Peaks of the Himmaleh Mountains, . .	between 26,462 and 17,017	
7	Volcano . . .	12,400	I. of Sumatra.
8	Chumuralee . .	11,980	Himmaleh.
9	Lebanon . . .	9,520	Syria.
10	Ararat	9,500	Armenia.
11	Me Lin Mountains	8,200	China.
12	Ida	5,800	Turkey.
13	Carmel. . . .	2,200	Palestine.

AMERICA.

1	Chimborazo . .	21,440	Andes.
2 & 3	Peaks of the Andes . . .		
4	Mt. Elias . . .	17,000	North America.
5	Mt. Fairweather .	14,900	" "
6	Coffre Peak . .	13,415	Mexico.
7	Rocky Mountains	12,500	North America.
8	Duida Volcano .	8,460	South America.
9	Mt. Washington (White Mts.)	6,634	United States.
10	Mount Katahdin .	5,300	" "
11	Moose Hillock .	4,500	" "
12	Saddle Mountain	4,000	" "
13	Round Top (Catskill Mountains)	3,800	" "
14	Ascutney . . .	3,300	" "
15	Mount Tom . .	1,500	" "
16	Mount Holyoke .	1,250	" "

AFRICA.

No. in plate.	Mountain.	Height.	Place.
		Feet.	
1 & 2	Geesh (highest) .	15,050	Abyssinia.
3	Atlas	12,500	Barbary.
4	Peak of Teneriffe	12,358	Canary Islands.
5	Compass . . .	10,000	Cape of Good Hope.
6	Volcano . . .	7,680	I. of Bourbon.
7	Pyramid . . .	487	Lower Egypt.

EUROPE.

1	Mont Blanc . .	15,735	Alps.
2	Rosa	15,600	"
3	Jungfrau . . .	13,718	"
4	Saint Michel } Mont Cenis } .	11,785	"
5	Mount Etna . .	10,936	Sicily.
6	St. Gothard . .	9,075	Alps.
7	Carpathian Mts. } (highest peak) }	8,870	Hungary.
8	Heidelberg . .	4,460	Germany.
9	Vesuvius . . .	3,978	Italy.
10	Hecla	3,690	Iceland.
11	Stromboli . . .	3,020	Lipari Islands.
12	Gibraltar . . .	1,439	Spain.
13	Ben Nevis . .	4,358	Scotland.
14	Snowden . . .	3,571	Wales.
15	Ben Lomond . .	3,420	Scotland.
16	M'Gillicuddy's } Reef }	3,404	Ireland.
17	Sea Fall Peak .	3,166	England.
18	Skiddaw . . .	3,022	"
19	Cader Idris . .	2,914	Wales.
20	Isle of Man . .	2,004	England.
21	Arran	2,945	Scotland.
22	Ailsa Rock . .	1,189	"

TABLE OF THE LENGTHS

OF THE

PRINCIPAL CHAINS OF MOUNTAINS.

Mountains.	Length.	Mountains.	Length.
	Miles.		Miles.
American chain .	11,500	Olonetz Mountains	1,000
Mexican & RockyMt.	7,000	Dofrafield Mountains	1,000
Altaian Mountains	5,000	Allegany Mountains	900
Andes . .	4,500	Alps and Appe-	600
Mountains of the Moon, supposed	2,000	nines, between	& 700
		CarpathianMountains	500
Ural Mountains .	1,500	Green Mountains	350
Mount Atlas . .	1,500	Pyrenees . . .	200

GLOSSARY, OR, EXPLANATIONS.

Alexander the Great,—"Macedonia's madman,"—a celebrated king of Macedonia, who was born 355 years before the birth of our Saviour, and died in the thirty-second year of his age. He was a great warrior, and conquered his enemies in every battle which he fought; and at last is said to have wept, because "there were no more worlds to conquer." He was proud, ordering himself to be worshipped as a god; and visited the temple of Jupiter Ammon in the Desert of Siwah, and bribed the priests of the temple to declare him to be the son of Jupiter. He was brave, often to rashness; humane and liberal; easy and familiar with his friends; and a great patron of learning. But he was a drunkard; and in one of his fits of madness, produced by intoxication and debauchery, he set fire to the city of Persepolis.

Allah, an Arabic word, literally signifying *the Adored*, and *the Adorable*. It is the Mohammedan name of God.

Alps, the name of the highest chain of mountains in Europe. It divides Italy from France, Switzerland, and Germany.

Ammon, a name by which the heathen deity, Jupiter, was worshipped in Africa. The name means sandy, and is sup-

posed by some to have had its origin from Jupiter's appearing in the form of a ram, and opening a spring in the sand, by stamping with his foot. It was probably in allusion to this circumstance, that in the temple erected to Jupiter in the Oasis of Siwah, called the temple of Jupiter Ammon, that deity was represented under the figure of a ram, or of a man with a ram's head or horns. The pillars of the temple were also crowned with representations of curled rams' horns.

Arabia, the most westerly portion of Southern Asia, between the Red Sea and the Persian Gulf.

Arbutus, an evergreen bushy tree, or creeping or trailing shrub, sometimes called the strawberry tree, or bearberry.

Avon, a river in Leicestershire, in England, which falls into the river Severn, at Tewksbury. The poet Shakspeare was born and died at the town of Stratford-on-Avon. There are three other rivers of the same name in England.

Carthaginian, belonging to Carthage, the most celebrated city of Africa, once the rival of Rome. It was founded about 850 years before the Christian era. This city flourished for about 737 years. It is said to have been twenty-three miles in circumference; and when it was finally destroyed by the Romans, it was set on fire, and burned incessantly for seventeen days.

Chute, a French word, signifying a waterfall or cataract.

Dead Sea, so called, from an erroneous tradition, that no animal could live in or near its waters. It is called, in the Bible, the Salt Sea, from the extreme saltness of its waters, and Sea of the Plain, or Sea of Siddim, because it occupies the place of the ancient Plain of Siddim. It is also called Lake Asphaltites, and Bituminous Lake, from the quantities of asphaltos or bitumen, which are found in its waters. It is situated at the south part of Palestine, east of the province of Judea.

Diodorus Siculus, an historian who flourished about forty-four years before Christ. He was surnamed Siculus from being born in Sicily. He wrote a history of Egypt, Persia, Syria, Media, Greece, Rome, and Carthage; and in order to qualify himself for the task, he is said to have visited all the places of which he has made mention.

Drift-wood, trees, logs, or other pieces of wood, which float down rivers or in the sea.

Egypt, a country of Africa, situated on the Mediterranean. It was formerly a mighty empire, and the seat of high civilization, the sciences, and the arts.

Equator, or *Equinoctial line*, an imaginary line passing round the earth, from east to west, and directly under the sun, which always shines nearly perpendicularly down upon all countries situated near the Equator.

Friday, the name of the Indian who lived with Robinson Crusoe on his desolate island.

Geographical square mile. A geographical mile is the sixtieth part of a degree, and is about one sixth more than a common English mile—sixty geographical miles being equal to sixty-nine and a half English miles. A common *square mile* is equal to a square surface, one mile on each side. Two square miles are equal to two of the squares of one mile put together, or a surface two miles long, and one mile wide. Four square miles are equal to four of the mile squares put together, or a surface four miles long and one mile wide, or a surface two miles on each side. A geographical square mile, then, is equal to a square surface, each side of which is one geographical mile, or about one and one sixth English mile. Sixty geographical square miles, will, of course, be equal to a surface sixty-nine and one half miles long, and one and one sixth mile wide.

Gilead, a mountainous region in Palestine or the Holy Land, on the east of the river Jordan. It was anciently celebrated for its balsam or balm.

Granite, one of the oldest rocks which are to be found on the globe; and that upon which other rocks principally rest.

Horicon, *Lake*, or Lake of the Silver waters, the Indian name of what is generally called Lake George. The extreme purity of its waters induced the French to call it *Lac Sainte Sacrement*, or Lake of the Holy Sacrament.

Inquisition, a tribunal or court established in some Roman Catholic countries, for the trial of offences against the faith of the Church. On page 247, the word is used for the building in which the tribunal was held.

Ishmaelites, descendants of Ishmael, the son of Abraham.

Jews, descendants of Jacob.

Jupiter, the supreme deity of the ancient heathens. He is called by various other names in different countries, as Osiris, in Egypt, Ammon, in other parts of Africa, Belus, in Babylon, &c.

Laws of Nature, the laws or mode by which the Deity is pleased to act, in relation to the works of Nature.

Mecca, a city of Arabia, in Asia, celebrated as the birthplace of Mohammed; it is about a day's journey from the Red Sea. It is entirely supported by the concourse of pilgrims from every part of the Mohammedan world, who annually flock thither to visit the temple within which is the Kaaba, or house of the Prophet.

Milan, a large and fine city of Italy; it contains a church, which, next to that of Saint Peter's at Rome, and Saint Paul's at London, is considered the grandest in Europe.

Mohammedan, a follower of, or believer in, the doctrines of Mohammed, a celebrated impostor, who was born at Mecca, in Arabia, in the year of our Lord 569, and who, in the the year 609, announced himself as the apostle or prophet of God. His doctrines were widely disseminated by means of violence and the sword; and, to this day, they extensively prevail in Asia and Africa. He died at Medina, in Arabia, A. D. 632.

Mont Blanc, the highest mountain of the Alps; it is so called from its white appearance, (*blanc* signifying white,) produced by the snow which covers its sides and summit.

North Pole, the north end of the axis, or imaginary line, passing through the centre of the earth, from North to South, and on which the earth is supposed to turn. The ends of this imaginary line or axis, are called the poles of the earth.

Palm, a beautiful tree which grows in tropical climates, to a very great height. Its trunk is very straight, and has no branches. The fruit, called dates, grows in clusters at the top, and the leaves, which are very long, branch out on all sides, presenting something of the shape of an umbrella. The trees are said never to wither, except they have been injured by some instrument. When this is the case, the

tree is cut down and burned on the spot, and the ashes are covered over the root, from which a new shoot soon arises, which in a few years becomes a strong and vigorous tree. The Greek name of the palm tree is Phœnix ; and it has been supposed that the fable of the bird of that name rising from its ashes, had its origin in this circumstance in the history of the palm tree. The cocoa-nut is a species of the palm.

Patmos, an island near the coast of Asia Minor. It is principally celebrated as the spot where Saint John retired, and where he wrote the Revelation, which constitutes the last book of the New Testament.

Piedmont, a province in the northwest part of Italy.

Prophet, a title taken by Mohammed, and to this day applied to him by the followers of his doctrines.

Rimmed, bordered.

Robinson Crusoe, history of, a fictitious narrative, which was written by Daniel Defoe, and founded on the adventures of Alexander Selkirk, a Scotchman, who was cast away on the Island of Juan Fernandez, in the Pacific Ocean.

Serapis, one of the tutelary gods of the Egyptians, supposed to be the same with the deity called Osiris, and the Grecian Jupiter. The worship of Serapis was introduced into Rome by the emperor Antoninus Pius, A. D. 146. It was so licentious that the Senate soon after abolished it. The ruins of a temple of Jupiter Serapis, near Naples, are said to be by far, the most beautiful monument of Roman antiquity remaining.

Simplon, one of the mountains of the range called the Alps. It is 10,600 feet high. The Emperor Napoleon laid out a very remarkable road over and through this mountain.

South Pole, the south end of the axis of the earth, opposite the North Pole.

Suedeland, Sweden.

Syracuse, a seaport town in Sicily ; it was formerly a superb city and flourishing republic, but war, tyranny, earthquakes, and time, have almost destroyed it.

Temple of Serapis, see *Serapis*.

Thucydides, the most celebrated of all the Greek historians. He was born at Athens, 470 years before the birth of Christ, and died in the seventieth or eightieth year of his age.

Titus, (Vespasianus,) an emperor of Rome, who was born, A. D. 40. He was celebrated for his valor in the Roman armies, particularly at the siege of Jerusalem. In the seventy-ninth year of the Christian era, he was made emperor, and from his previous conduct the Roman people were apprehensive that he would be guilty of great barbarity and gross debaucheries. Much to their agreeable disappointment, he thought himself bound to be the father of his people, the guardian of virtue, and the patron of liberty ; and he is, perhaps, the only monarch who, when invested with uncontrollable power, bade adieu to those vices, luxuries, and indulgences, which, as a private man, he never ceased to gratify. To do good to his subjects, was the ambition of Titus ; and it was at the recollection that he had done no service, or granted no favor, one day, that he made the memorable exclamation, "*My friends, I have lost a day.*" He reigned only two years, and died in the year of our Lord 81, in the forty-first year of his age. Then, "Rome was filled with tears, and all looked upon themselves as deprived of the most benevolent of fathers."

Torrid Zone, that part of the earth lying under the Equator, and between what are called the Tropics, and on which the sun sheds his most intense heat. The greater part of Africa is within this Zone.

Trailed, drawn out in length.

Turks, natives of Turkey, an extensive empire situated in the southeastern part of Europe, and western part of Asia, bordering on the Mediterranean and Black Seas, and governed by the Grand Signior, who resides at Constantinople.

Unicorn, an animal with one horn upon his forehead. It was long supposed that the accounts of the existence of such an animal were fabulous ; but it is now stated that a beast answering to this description is found in Ethiopia, of the size of a cow, and having the form of an antelope.

Unique, without an equal, without another of the same kind known to exist.

INDEX.

A.

Aborigines, their practice in naming places, 117.
Ache, Falls in the, 60.
Acid, 174.
Adige, 47, 121, 148.
Æolus, Cave of, 81.
Africa, 239, 259.
Air, currents of, 158, 161, 211.
——, expansion of, 211.
——, explosion of, 211.
——, of mountains, effect of, on the human system, 57, 136.
——, thinness of, on mountains, 57.
——, what, and where most easily breathed, 57.
Aleppo, earthquake at, 255.
Alexander the Great, 265.
Alkali, 174.
All things useful, 272.
Alleghanies, 88.
Alps, 11, 40, 45, 50, 54, 87, 90, 133, 239.
Amazon River, 83, 86, 119.
America, 84.
————, discovery and rediscovery of, 85.
————, grass plains in, 239.
————, steppes of, 266.
Ammon, Jupiter, temple of, 265.
Andes, 50, 85, 239, 243.
Animalculæ, 283.
Animal food, exclusively used by the drovers of South America, 268.
Animals, organs of, 286.
————, destruction of by one another, 292.
————, in the sea, 112.
————, rocks formed by, 281.
Antioch, earthquake at, 254.
Antisana, farmhouse of, 54.
Appennines, 14, 121, 140, 239.
————, rivers of, 117, 121.
Aqueduct at Lisbon, 247.
Arabs, wild, 264.
Army, Carthaginian, arrested by lava, 230.
Arno, 15, 118, 121, 140, 148.
Arve, 143, 145.
Ascent of Chimborazo, 54.
——— of Mont Blanc, 135.
——— of Mount Vesuvius, 198.
Ashes, shower of, 210, 220, 235, 254.
Asia, 239, 259.
——, steppes of, 266.
Attachment to place regardless of danger, 249.
Audubon's notice of Niagara Falls, 70.
Austrian mile, 203.
Auvergne, mountains of, 238, 243.
————, hot spring in, 193.
Avalanche, 133.
Avon, 25.
Azores, Isles, 110.

B.

Bagnold, Captain, on frequency of earthquakes, 248.
Baker's account of the earthquake at Aleppo, 255.
Ballston Springs, 182, 191.
Bascom's, Mr., notice of Niagara Falls, 72.
Baths of Nero, 193.
Battle between a whale, herrings, and sea-gulls, 114.
Beach at Newport, 177.
Beacon Hill, Boston, 101.
Beaver, 114.
Bernard, Mount St., 54.
————, ——— —, dogs of, 54.
————, ——— —, preservation of dead bodies at, 55.
Birds, 114, 293.
Black Sea, 141, 142.
——— water, 143.

Blood forced from the body on Mount St. Bernard, 57.
Boat, 16, 24, 94.
—— carriage, 94.
Boiling springs of Iceland, 194.
Borromei Islands, 48.
Boston, 101.
Brainard's lines on Niagara Falls, 82.
Bread, dried meat substituted for, in South America, 268.
Breathing difficult on high mountains, 57.
Bricks, 275.
Brimstone, 201.
Brooks, 21.
Buenos Ayres, the Pampas of, 267.
Building, Chilian mode of, 252.
Buildings, materials for the construction of, 275.
Bunker Hill, 101.
Burning mountains, 238.
Byron's description of the Falls of Velino, 61.

C.

Camels, employment of, 262, 264.
Canada, skating in, 56.
Canary Isles, 110.
Cannon, firing of, 210.
Canoe drifted to one of the islands of Scotland, 274.
Cape Cod, action of the sea upon, 117.
————, by whom, when, and why so called, 117.
—— Teneriffe, 50.
Caravan, 262.
Carmine, whence obtained, 144.
Carriage, modes of, 94.
Carthaginian army arrested by flowing lava, 230.
Cascade, 58, 60, 68.
Caspian Sea, 154.
Catania, 230.
Cataracts, 58, 60, 68, 236.
Cattle used for fuel, 268.
Catskill Mountains, 52.
Cause of volcanic eruptions, 217.
Cave of Æolus, or of the Winds, 80.
Chains of burning mountains, 239, 241.
Chalybeate springs, 191.
Chamouni, 134.
Charcoal, purifying qualities of, 183, 188.
Charcoal, what made of, 184.
Chaudiere Falls, 68.
Chilian mode of building, 252.
Chili, coast of, upraised by earthquakes, 250.
——, earthquakes on the coast of, 248, 250.
——, number of volcanoes in, 237.
Chimborazo, 53.
Clothes, how dried, 150.
Coasts, rocky, 281.
———, sandy, 281.
———, upraising of, 225, 250.
Color of rivers, 118, 142.
Columbus, 85, 119, 158, 163.
———— discovered the trade-winds, 158.
Combustion, spontaneous, 214.
Common, Boston, 102.
Communication between volcanoes, 226.
Conception, earthquakes at, 248, 251.
Contents, Table of, 7.
Convent of Mount St. Bernard, 54.
Copp's Hill, Boston, 101.
Coral, 281.
——, why thought to be vegetable, 282.
Cotopaxi, 210.
Crater of Vesuvius, 199, 226.
————————, descent into, 201.
Creek, 59.
Crescent Fall, 74.
Crevasses, 135.
Currents of air, 158, 161.
———— of water, 118, 138.
———— of wind, 158.
Czirknitz Sea, 36.

D.

Danger, disregard of, 227, 249, 252.
Danish mile, 203.
Danube, 141.
Daubeny on saltness of the ocean, 171.
Davy, Sir Humphrey, 217.
Dead bodies preserved at the convent of St. Bernard, 55.
—— Sea, 154, 177.
Deltas, 139.
Depth of sea, 171.
Desert of Libya, 265.
Desert; mode of crossing, 262.

Desert, origin of, 261.
———, of Sahara, 265.
———, sandy, 239, 259.
Diffused, meaning of, 190.
Dikes, 121.
Diodorus Siculus, 230.
Dissolved, meaning of, 188.
Dogs of Mount St. Bernard, 54.
Drance, overflow of, 41.
Drovers in South America, 267.
———, use animal food exclusively, 268.

E.

Earth, colors of, 278.
———, level originally, 240.
———, upraising of, 207.
———, varieties of, 275.
Earthquakes, 205, 207, 209, 223, 236, 244, 248, 253, 288.
———, frequency of, 248, 251.
———, length of continuance of shocks of, 251.
———, loss of lives by, 246.
———, most violent one in Europe, 244.
———, reflections on, 249, 258.
———, shelter from, 253.
Ebro River, 148.
Elevation of the ground by subterraneous fires, 207.
——— of mountains by subterraneous fires, 207.
——— of sea-coast, 250.
Embankments, 29, 39, 120.
England, 84, 90.
English mile, 203.
Epsom salts, 175.
Equator, 158.
Eruptions, submarine, 110, 231.
———, volcanic, 198.
Etna, 203, 230.
———, height of, 204, 230.
Europe, grass plains of, 239.
———, highest spot in, 50.
———, hottest spring of, 193.
———, number of volcanoes in, 237.
Evaporation, 149, 172.
Exhalations, 180.
Expansion of air, 211.
Explanations, 298.
Explosion of air, 211.
Extinct volcanoes, 238, 249.

F.

Falls, 58, 60, 67.
——— in Ache River, 60.
——— of Chaudiere, 68.
——— of the Housatonic, 61.
——— of Lodore, 64.
——— of the Missouri, 62.
——— of Montmorenci, 67.
——— of Niagara, 70.
——— near Schaffhausen, 60.
——— of the Staubbach, 58.
——— of Terni, 60.
——— of Tivoli, 60.
——— in the Tockoa Creek, 59.
——— of Trenton, 62.
Feeders, 91.
Ferrara, 122.
Filter, 289.
Filters, description of, 183.
Fire, action of water on, 216.
———, subterraneous, action of, 207, 235, 239.
Fish, 112, 292.
Fissures, volcanic, 230.
Flood, 119.
Fog, 180.
Food, animal, exclusively used by the South American drovers, 268.
Force, what, 208.
Formation of mineral springs, 196.
——— of soil, 259, 269.
——— of volcanoes, 238.
Fort Hill, Boston, 101.
France, how divided from Spain, 89.
———, how divided from Switzerland, 90.
Freshet, 119.
Fruit, 124.
——— trees, why they have not slender branches, 124.
Fuel, cattle used for, 268.

G.

Gamboge, how obtained, 143.
Ganges, 86, 119, 141.
Geneva, Lake, 42, 46, 142.
———, Town, 46.
George, Lake, 142.
German mile, 203.
Germination of plants, 260.
Geyser, 195.
Gibraltar, Straits of, 155.
Glaciers, 135.
Glauber's salts, 175.

Glossary, 298.
Goat Island, 76.
God, the goodness of, 113, 123, 258, 271, 293.
Goldau, accident at, 126.
Gomorrah, 177.
Gosnold, Captain, named Cape Cod, 117.
Grahame, Mrs., her remarks on the upraising of the Chilian coast, 250.
Grass plains, 239, 266.
—— supporting mountains, 272.
Greenwood, F. W. P., notice of Niagara Falls by, 72.
Guanca Velica in Peru, 54.
Guides in deserts, 262.
Gulls, sea, 114.
Gunpowder, 210, 212.

H.

Heat of bodies, the length of time it continues, 198.
Hecla, 236.
Hennepin's notice of Niagara Falls, 70.
Herculaneum, destruction of, 220.
————, rediscovery of, 222.
Herring, 112.
Himmaleh Mountains, 53, 85, 141, 243.
Horicon, Lake, 143.
Horses, 94.
Horse-shoe Falls, 75.
Hot springs, 192.
————, number of in Iceland, 194.
Houses, construction of in Pompeii, 222.
Humboldt, his ascent of Chimborazo, 54.
————, remarks on earthquakes, 249.
————, remarks on Peak of Teneriffe, 210.
Hurricane, 163.
———— in the West Indies, 165.
Hyacinths grow in water, 271.

I.

Iceland, 194, 235.
————, earthquakes in, 236.
————, hot springs of, 194.
————, volcanoes of, 236.
Icelanders, 194.
Ice, sea of, 134.
Indians, their practice in naming places, 117.
Ingraham, J. W., his notice of Niagara Falls, 80.
Inhabitants destroyed by earthquakes, 246, 254.
———— by hurricanes, 165.
———— by volcanic eruptions, 221.
Iron, 215.
—— springs, 191.
Ishmaelites, 263.
Islands, 31, 108. 110.
————, Azores, 110.
————, Borromei, 48.
————, Canaries, 110.
————, Icelandic, 235.
————, Lipari, 110.
————, Sabrina, near St. Michael's, 110, 235.
————, Santorino, 234.
————, volcanic, 110, 232.
————, why so called, 111.
Isola Bella, 48.
Italy, 90.

J.

Java, volcano in, 254.
Jorullo Mountain, 207.
Joseph hidden in a well, 263.
Jupiter Ammon, temple of, 265.
Jura Mountains, 90.

K.

King of Naples, offer to certain individuals by, 249.

L.

Lake, formation of, 48.
——, (paint,) of what made, 144.
Lake Como, 48.
—— George, or Horicon, 142.
—— Geneva, 42, 46, 142.
—— Maggiore, 48.
Lakes, 29, 35, 154.
Land carriage, 94.
—— effect upon by the sea, 117.
—— and water, proportion of, 112.
Landslip, 125, 129.
———— cause of, 129.
———— at Goldau, 126.

Landslip at the White Mountains, 130.
Lattin Falls, 60.
Lava, 198, 202, 204, 210, 227, 230.
——, appearance of, 204.
——, speed of current of, 204.
——, of what it consists, 199.
Lebanon Springs, 192.
Lengths of principal mountain chains, 53, 298.
—— rivers, 83.
Levee at New Orleans, 120.
Libya, desert of, 265.
Lichens, 270, 275.
Lima, earthquake at, 254.
Limestone, 276.
Limewater, 188.
Lio, St., fissure in the plain of, 230.
Lipari Isles, 110.
Liquids, when they evaporate, 152.
Lisbon Aqueduct, 247.
——, earthquake at, 244, 251.
Lives lost by earthquakes, 246, 252, 254, 255.
—— hurricanes, 165.
—— volcanic eruptions, 221.
Lodore Falls, Southey's description of, 64.
London fog, 180.
Lot's wife, 177.
Lucifer matches, 218.
Lyde, 56.

M.

Madder, of what made, 144.
Map of Mountains, preceding the Title.
Marble cascade, 61.
Marine plants, 112, 174.
Market, 98.
Martigny, 41.
Mason bees, 284.
Matches, Lucifer, 218.
Materials carried along by currents, 118.
Meat, dried, substituted for bread, 268.
Mediterranean, 47, 148, 154, 281.
——, volcanic islands in, 232, 234.
Medway River, 26.
Meeting of a river and the ocean, 138.
Men, the hire of, 99.
Mer de glace, 134.
Mexico, earthquakes at, 250.
Miles, different lengths of, 203.
Minerals, 286.
Mineral springs, 182, 191.
——, how formed, 196.
Mississippi, 26, 83, 120.
Missouri, 26, 83.
—— Falls, 62.
Mists, 180.
Mohammedan pilgrims, 263.
MontBlanc, 11, 13, 40, 45, 50, 54, 135.
——, ascent of, 135.
——, view from, 136.
——, why so named, 136.
Monte Nuovo, formation of, 224.
——, plants on, 269.
——, soil of, 269, 274.
Monte Rossa, 224.
Montmorenci Falls, 68.
Montpelier, 238.
Morocco, village destroyed by earthquake near, 247.
Mosses, 270.
Mound, 39.
Mount Etna, 203, 230.
—— Hecla, 236.
—— Jorullo, 207.
—— Jura, 90.
—— Rosso, 207.
—— Saint Bernard, 54.
—— Vesuvius, 198, 203, 210, 220, 222, 225, 226.
Mountains of Auvergne, 238, 243.
——, burning, 238.
——, formation of, 238.
——, grass supporting, 272.
——, heights of, 51, 296.
——, highest, 85.
——, Lengths of chains of, 53, 298.
——, Map of, preceding the Title-page.
——, production of, 238.
——, to prevent the crumbling of, 122.
——, under the sea, 111.
——, upheaving of, 207, 239.
——, view from, 136.
——, volcanic, 210, 220.
——, sudden formation of, 223.
Mud, why it does not sink to the bottom of a river, 117.
Museum at Naples, 223.

N.

Nantucket, 280.
Naples, 229, 249, 253.
———, earthquakes at, 253.
———, Museum at, 223.
Nature, laws of, 47.
———, meaning of, 271.
———, wisdom of, 22, 28.
Nero, baths of, 193.
New England, effect of the sea upon the coast of, 117.
New Orleans, 120.
Newport Beach, 177.
New York, 98.
Niagara Falls, 70.
Nidder, Krug Von, account of Icelandic Hot Springs by, 195.
Nile, 28, 139.
North wind, why not constant, 163.
Notch of the White Mountains, 131.
Nourishment of plants, 276.

O.

Oases, description of, 265.
Ocean and river, meeting of, 138.
Oceans, 148.
Ochres, 143, 278.
Ohio River, 120.
Ore, iron, 215.
Organs of animals, 286.
——— of plants, 285.
Orinoco River, 119, 120.
Overflow of rivers, 41, 119.
———, ingenious method to prevent, 42.
——— of the Drance, 41.
——— of the Nile, 139.

P.

Pacard, Dr., ascent of Mont Blanc by, 135.
Paints, what made of, 143.
Pampas of South America, 267.
Papandayang Volcano, Island of Java, 254.
People destroyed by earthquakes, 246.
——— by hurricanes, 165.
——— by volcanic eruptions, 221.
Philadelphia, 98.
Place, attachment to, 249.
Plains, grass, 239, 266.
———, of sand, 239, 259.
Plants, different parts of, 285.
———, food of, 272.
———, growth of, 271.
———, marine, 112, 174.
———, on Monte Nuovo, 269.
Po River, 121, 122, 140, 148.
Poetical description of the Falls of Lodore, 64.
Poles, north and south, 157, 158.
Pompeii, destruction of, 220.
———, rediscovery of, 222.
Ponds, 18, 29, 34, 105, 117, 184.
———, supplying of with water, 34, 105.
Portuguese mile, 203.
Potassium, 217.
Pourers, 91.
Power, what, 208.
——— of steam and water, 209.
Preface, 3.
Providence, wisdom of, 152, 258, 270.
Prussian blue, whence obtained, 144.
——— mile, 203.
Pumice, large quantities thrown out by volcanic action, 235.
Puzzuoli, 223.
Pyrenees, 89.
Pyrites, 196.

Q.

Quito, 54, 58.

R.

Rain, 172, 179, 210.
Rapids, 76.
Red Sea, origin of the name of, 144.
Reed and Matheson's notice of Niagara Falls, 71.
Reefs, coral, 281.
Rents made by volcanic action, 203, 230.
Reservoir, 18, 22, 88, 105, 129, 152, 184, 216, 260.
Revolutionary War, 101.
Rill, 289.
River Adige, 47, 121, 148.
—— Amazon, 83, 86.
—— Arno, 15, 118, 121, 140, 148.
—— Arve, 143, 145.
—— Avon, 25.
—— Black Water, 143.
—— Danube, 141.
—— Drance, 41.

River Ebro, 148.
—— Ganges, 86, 141.
—— Medway, 26.
—— Mississippi, 26, 83, 120.
—— Missouri, 26, 83.
—— Nile, 28, 139.
—— Ohio, 27, 120.
—— Orinoco, 119, 120.
—— Po, 121, 122, 140, 148.
—— Red, 143.
—— Rhine, 70, 87, 121.
—— Rhone, 46, 142, 145, 148.
—— Saint Lawrence, 119.
—— Severn, 26.
—— Skapta, 236.
—— Thames, 26.
—— Tiber, 101, 118, 148.
—— Yellow Stone, 144.
Rivers, 15, 21, 69, 83, 107, 240.
——, color of, 118.
——, course of, 83, 107.
——, lengths of, 83, 90.
—— of England, 90.
—— of the Appenines, 117, 121.
——, size of, 90.
——, the distance they will carry solid materials, 118.
——, use of, 87, 240.
Rivulets, 21, 69, 85, 106, 240, 289.
Rome, 101.
Roots to prevent the crumbling of mountains, 122.
Rosso, Mount, 207, 224.
Round Top Mountain, 52.
Row-boat, 98.
Russian mile, 203.
Russia, steppes of, 266.

S.

Sabrina, 110, 235.
Sahara Desert, 265.
Sail-boat, 94.
Sailors, 111.
Saint Lawrence River, 119.
Salt in deserts, 261.
—— lakes, 176.
——, quantity of, in the ocean, 171.
—— springs, 176.
Saltness of the sea, the cause of, 168.
Salts, kinds of, 174.
Sand, storms of, 264.
Sands of the sea, 280.
Sandy deserts, 239, 259.
Santorino, volcanic island of, 234.
Saratoga Springs, 191.
Saussure, M. de, 135.
Schaffhausen, cataract near, 60.
Schlosser Fall, 80.
Sciasconsett, 280.
Sea, 154.
——, average depth of, 171.
——, Black, 141, 142.
——, Caspian, 154.
—— coast, volcanic elevation of, 225, 250.
——, Dead, 154, 177.
——, effect of, upon the land, 117.
—— gulls, 114.
——, Mediterranean, 47, 148, 154.
—— of ice, 134.
—— plants, 112, 174.
——, Red, origin of the name of, 144.
——, saltness of, 168.
——, whence it receives water, 153.
——, why it does not overflow, 148.
——, Zirknitz or Czirknitz, 36.
Seeds, growth of, 259.
——, transportation of, by animals, air, and water, 270, 274.
Serapis, temple of, 225.
Severn River, 26.
Shakspeare, 25.
Shell-fish, 112.
Shells, 281.
Shepherds, South American, 267.
Ships, 94.
Shock of earthquakes, 251.
——————, time of continuance of, 251.
Siculus, Diodorus, 230.
Simoom wind, 263.
Simplon, 88.
Skapta River, 236.
Skaptar Jokul Volcano, 204, 236.
Skating in Canada, 56.
Skeletons found at Pompeii and Herculaneum, 221.
Sky, 179.
Soda, 174.
Sodom, 177.
Soil, formation of, 259, 269, 276.
——, fitness of, for vegetation, 276.
Solid materials, the distance rivers will carry, 118.
Sounding line, 111.
Southey's description of a waterfall, 64.
Spain, mountains dividing it from France, 89.
Spawn, 113.

Speculation, bad consequences of, 102.
Spontaneous combustion, 214.
Springs, 19, 34, 88, 105, 182, 191, 260.
———, Ballston, 182, 191.
———, intermittent, 108.
———, mineral, 182, 191, 290.
Spring water, why so pleasant, 182.
———————, whence the name, 106.
Stafford Springs, 192.
Stappafoss, Cataract of, 236.
Staubbach, Cataract of, 58.
Steam, 110, 209, 211.
———, and water, difference of room they occupy, 211.
———————, power of, 211.
Steam-boat, 96.
Steppes, 266.
Stone, history of a, 287.
Stones, increase of, 287.
———, quantity of, 284.
Straits of Gibraltar, 155.
Streams of lava, 202.
Strength, use of the term, 208.
Strokr Spring, 195.
Stromboli, 237.
Submarine land, 110.
——— volcanoes, 110, 231.
Subterraneous fires, action of, 207, 239.
Sulphur, 191, 201, 216.
——— Springs, 191.
Sumbawa, volcano on the Island of, 253.
Suspended, meaning of, 190.
Swedish mile, 203.
Switzerland, 90.

T.

Table land, meaning of, 54.
——— of Contents, 7.
——— of heights of mountains, 51, 296.
——— of lengths of principal mountain chains, 53, 298.
——————— of principal rivers, 83.
Table Rock, 73.
Tempest, 164.
Temple of Jupiter Ammon, 265.
——— of Serapis, 225.
Teneriffe, Cape, 50.
Teneriffe, Peak of, 210.
Termination Rock, 77.
Thames, 26.
Theatre at Pompeii and Herculaneum, 223.
Thuez, Spring of, 193.
Tiber, 101, 118, 148.
———, why called yellow, 118.
Tides, none in the Mediterranean Sea, 281.
Tockoa Creek, 59.
Tombaro Volcano, in the Island of Sumbawa, 253.
Torre del Greco, 227.
Torrents, 22.
Torrid Zone, 120, 158.
Tow-boat, 95.
Town, best situation for, 93, 100, 103.
Towns at the West, 102.
Trade winds, 158.
Travelling across deserts, 262.
Tremount, 101.
Trenton Falls, 62.
Tripergola, 223.
Tripoli earth, 283.
Turf prevents the crumbling of mountains, 122.

U.

Upheaving of mountains, 207, 239.
Upraising of coast, 225, 250.
——————— of ground, 207.
Usefulness stamped on all things, 272.

V.

Valley, 15.
Vapor, 153, 172, 180.
Vegetable mould, 269, 277.
——————— nutrition, 276.
Vegetables, 269.
Vegetation, 260, 276.
Velocity of currents, 118.
Versans, what, 91.
Vesuvius, 198, 203, 210, 220, 222, 225, 226, 249.
Vinet's, Mr., mode of preventing freshets, 41, 43.
Virginia Hot Springs, 192.
Volcanic ashes, 210, 220.
——————— eruptions, cause of, 217.
——————— islands, 232.
——————— mud, 210, 220.
——————— rent, 208, 220.

Volcanoes, 110, 194, 197, 203, 237, 243, 253.
———, chains of, 241.
———, communication between, 226.
———, extinct, 238, 243.
———, formation of, 238.
———, largest known, 243.
———, number of, 237.
———, submarine, 110, 231.

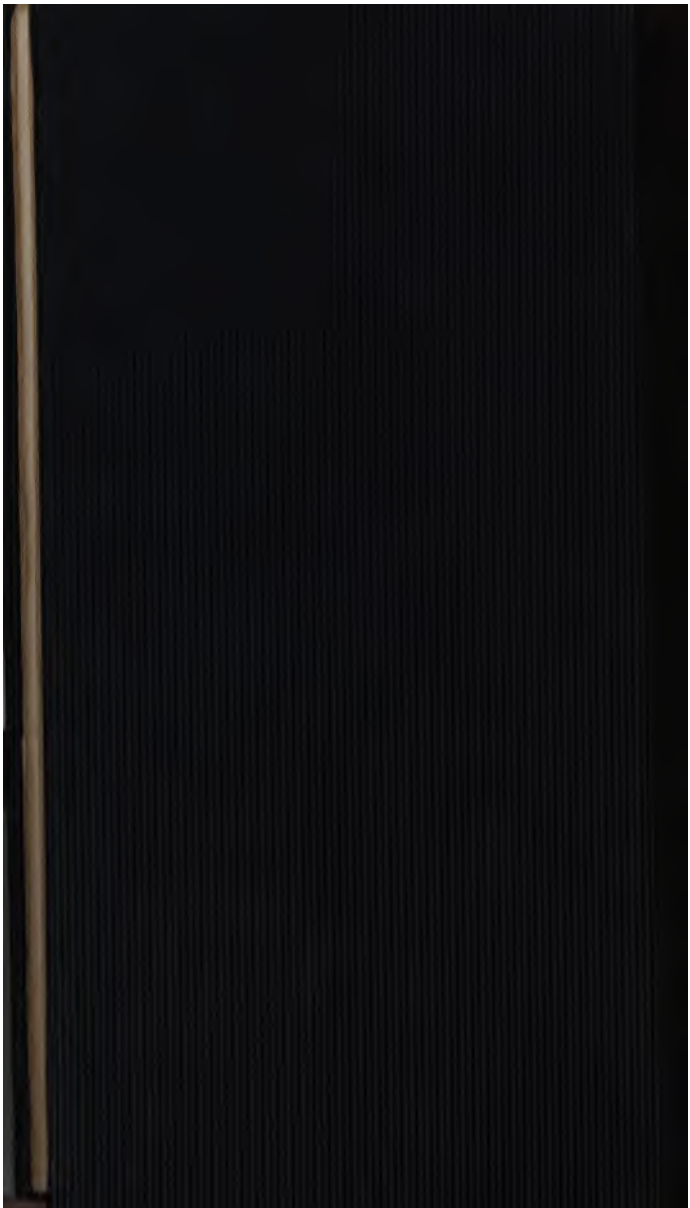
W.

Warm and Hot Springs of Virginia, 192.
Water, action of, on fire, 216.
——— and land, proportion of, 112.
——— and steam, difference of room occupied by, 211.
———, different power of, 211.
——— carriage, 94.
Waterfalls, 59.
Waterfowl, 114.
Water, hyacinths grow in, 271.
Water, lime, 188.
———, mineral, 182.
———, mixed with ashes, 210.
———, power of, 209.
———, purifying of, 183.
Water, spring, 182, 191.
———, transparent, when, 190, 197.
Waters of river and ocean meeting, 138.
Weeds, 112.
Well, Joseph hid in, 263.
Wells, 261.
West Indies, 164.
———, hurricane in, 165.
Whale, 114.
Whirlwind, 164.
White Mountains, landslip at, 130.
Wild Arabs, 264.
Willis, N. P., description of Trenton Falls by, 62.
Wind, 94, 158.
———, cause of, 158.
———, Simoom, 263.
———, Trade, 158.
———, velocity of, 163.
———, what, 150.
Wisdom of God, 47, 57, 123, 152, 162, 258, 270.

Y.

Yellow Stone River, 144.

Z.

Zirknitz Sea, 36.

THE END.